



# UNITED STATES AIR FORCE RESEARCH LABORATORY

---

## EVALUATING AIRCREW AND MAINTAINER WARFIGHTER PERFORMANCE IN AERONAUTICAL SYSTEMS USING MISSION- ORIENTED MEASURES OF EFFECTIVENESS

P. SCOT BEST  
FRANK C. GENTNER  
PAUL H. CUNNINGHAM  
TERRENCE C. TILLER  
AARON W. SCHOPPER  
JASON D. MORRIS

University of Dayton Research Institute  
Human Factors Group  
300 College Park  
Dayton, OH 45469-0157

WINSTON BENNETT, JR.

Air Force Research Laboratory  
Warfighter Training Research Division  
6030 South Kent Street  
Mesa AZ 85212-6061

February 2001

AIR FORCE RESEARCH LABORATORY  
HUMAN EFFECTIVENESS DIRECTORATE  
WARFIGHTER TRAINING RESEARCH DIVISION  
6030 SOUTH KENT STREET  
MESA, AZ 85212-6061

Approved for public release;  
distribution is unlimited.

REPORT DOCUMENTATION PAGE				Form Approved OMB No. 0704-0188	
Public reporting burden for this collection of information is estimated to average 1 hour per response, including the time for reviewing instructions, searching existing data sources, gathering and maintaining the data needed, and completing and reviewing this collection of information. Send comments regarding this burden estimate or any other aspect of this collection of information, including suggestions for reducing this burden to Department of Defense, Washington Headquarters Services, Directorate for Information Operations and Reports (0704-0188), 1215 Jefferson Davis Highway, Suite 1204, Arlington, VA 22202-4302. Respondents should be aware that notwithstanding any other provision of law, no person shall be subject to any penalty for failing to comply with a collection of information if it does not display a currently valid OMB control number. PLEASE DO NOT RETURN YOUR FORM TO THE ABOVE ADDRESS.					
1. REPORT DATE (DD-MM-YYYY) 01-02-2001		2. REPORT TYPE Final		3. DATES COVERED (FROM - TO) xx-10-1995 to xx-04-1999	
4. TITLE AND SUBTITLE Evaluating Aircrew and Maintainer Warfighter Performance in Aeronautical Systems using Mission-Oriented Measures of Effectiveness Unclassified			5a. CONTRACT NUMBER F41624-97-C-5030		
			5b. GRANT NUMBER		
			5c. PROGRAM ELEMENT NUMBER 62202F		
			5d. PROJECT NUMBER 1123		
6. AUTHOR(S) Best, P. Scot ; Author Gentner, Frank C. ; Author Cunningham, Paul H. ; Author Tiller, Terrence C. ; Author Schopper, Aaron W. ; Author			5e. TASK NUMBER A2		
			5f. WORK UNIT NUMBER		
7. PERFORMING ORGANIZATION NAME AND ADDRESS University of Dayton Research Institute Human Factors Group 300 College Park Dayton, OH45469-0157			8. PERFORMING ORGANIZATION REPORT NUMBER		
9. SPONSORING/MONITORING AGENCY NAME AND ADDRESS Air Force Research Laboratory Warfighter Training Research Division 6030 South Kent Street Mesa, AZ85212-6061			10. SPONSOR/MONITOR'S ACRONYM(S) AFRL; AFRL/HEA		
			11. SPONSOR/MONITOR'S REPORT NUMBER(S) AFRL-HE-AZ-TR-2000-0129		
12. DISTRIBUTION/AVAILABILITY STATEMENT APUBLIC RELEASE					
13. SUPPLEMENTARY NOTES Air Force Research Laboratory Technical Monitor: Dr Winston Bennett, Jr., AFRL/HEA, DSN 474-6297					
14. ABSTRACT Manpower, Personnel, and Training (MPT) research and development (R&D) traditionally validates its products and procedures using outcome criteria such as end-of-course grades, ?time to master,? cost-benefit analyses, or sometimes by job performance indices. However, R&D funders react more favorably to research outcomes linked to warfighting capabilities and readiness impacts. Therefore, incorporating these criteria into MPT R&D is critical to future success. The Air Force Research Laboratory commissioned the present effort to determine the key measures used by Air Force decision-makers at the headquarters and major command levels. One way to target human performance improvement research is to focus on the Measures of Effectiveness (MOEs) used to evaluate the performance of weapon systems, organizational units, teams or crews, and individual airmen on operational tasks. Based on input from a wide variety of sources, the University of Dayton Research Institute (UDRI) developed a taxonomy of warfighting capability metrics linking the priorities and preferences of Air Force operational command decision makers for specific MOEs. Research findings included: (a) MOEs were numerous but not well documented or organized in the literature, (b) individual systems acquisition documents possess many MOEs, and (c) surrogate measures used for exercises and contests can also be useful. In addition to the MOE taxonomy, UDRI developed an hierarchical diagram of aircraft maintenance MOEs.					
15. SUBJECT TERMS Aircraft, aircrew, and maintenance personnel performance; availability; combat readiness; crew performance measures; human factors; jobs; measures of effectiveness; measures of performance; measures of merit; MOE; MOM; MOP; Metrics; Taxonomy; teams; warfighting capability; training					
16. SECURITY CLASSIFICATION OF:		17. LIMITATION OF ABSTRACT		18. NUMBER OF PAGES	
a. REPORT Unclassified		b. ABSTRACT Unclassified		c. THIS PAGE Unclassified	
		Same as Report (SAR)		266	
				19. NAME OF RESPONSIBLE PERSON casey, Liz Liz.Casey@williams.af.mil	
				19b. TELEPHONE NUMBER International Area Code Area Code Telephone Number 480988-6561 DSN 474-6188	
				Standard Form 298 (Rev. 8-98) Prescribed by ANSI Std Z39.18	

## **NOTICES**

Publication of this report does not constitute approval or disapproval of the ideas or findings. It is published in the interest of STINFO exchange.

Using Government drawings, specifications, or other data included in this document for any purpose other than Government-related procurement does not in any way obligate the US Government. The fact that the Government formulated or supplied the drawings, specifications, or other data, does not license the holder or any other person or corporation, or convey any rights or permission to manufacture, use, or sell any patented invention that may relate to them.

The Office of Public Affairs has reviewed this report, and it is releasable to the National Technical Information Service, where it will be available to the general public, including foreign nationals.

This report has been reviewed and is approved for publication.

**WINSTON BENNETT, JR.**  
Project Scientist

**DEE H. ANDREWS**  
Technical Advisor

**JERALD L. STRAW, Colonel, USAF**  
Chief, Warfighter Training Research Division

Please do not request copies of this paper from the Air Force Research Laboratory. Additional copies may be purchased from:

National Technical Information Service  
5285 Port Royal Road  
Springfield, Virginia 22161

Federal Government agencies and contractors registered with the Defense Technical Information Center should direct requests for copies of this report to:

Defense Technical Information Center  
8725 John J. Kingman Road, Suite 0944  
Ft. Belvoir, Virginia 22060-6218

REPORT DOCUMENTATION PAGE			Form Approved OMB No. 074-0188	
Public reporting burden for this collection of information is estimated to average 1 hour per response, including the time for reviewing instructions, searching existing data sources, gathering and maintaining the data needed, and completing and reviewing this collection of information. Send comments regarding this burden estimate or any other aspect of this collection of information, including suggestions for reducing this burden to Washington Headquarters Services, Directorate for Information Operations and Reports, 1215 Jefferson Davis Highway, Suite 1204, Arlington, VA 22202-4302, and to the Office of Management and Budget, Paperwork Reduction Project (0704-0188), Washington, DC 20503				
1. AGENCY USE ONLY (Leave blank)	2. REPORT DATE February 2001	3. REPORT TYPE AND DATES COVERED Final - October 1995 to April 1999		
4. TITLE AND SUBTITLE Evaluating Aircrew and Maintainer Warfighter Performance in Aeronautical Systems Using Mission-Oriented Measures of Effectiveness		5. FUNDING NUMBERS C - F41624-97-5030 PE - 62202F PR - 1123 TA - A2 WU - 20		
6. AUTHOR(S) P. Scot Best, Frank C. Gentner, Paul H. Cunningham, Terrence C. Tiller, Aaron W. Schopper, Jason D. Morris, and Winston Bennett, Jr.				
7. PERFORMING ORGANIZATION NAME(S) AND ADDRESS(ES)  University of Dayton Research Institute Human Factors Group 300 College Park Dayton, OH 45469-0157  Phone: (937) 229-3217  E-mail: hfg@udri.udayton.edu		8. PERFORMING ORGANIZATION REPORT NUMBER		
9. SPONSORING / MONITORING AGENCY NAME(S) AND ADDRESS(ES)  Air Force Research Laboratory Human Effectiveness Directorate Warfighter Training Research Division 6030 South Kent Street, Bldg 561 Mesa, AZ 85212-6061  Phone: (480) 988-6561 DSN: 474-6297 E-mail: winston.bennett@williams.af.mil		10. SPONSORING / MONITORING AGENCY REPORT NUMBER  AFRL-HE-AZ-TR-2000-0129		
11. SUPPLEMENTARY NOTES Air Force Research Laboratory Technical Monitor: Dr Winston Bennett, Jr., AFRL/HEAA				
12a. DISTRIBUTION / AVAILABILITY STATEMENT  Approved for public release; distribution is unlimited.			12b. DISTRIBUTION CODE  A	
13. ABSTRACT (Maximum 200 Words) Manpower, Personnel, and Training (MPT) Research and Development (R&D) traditionally validates its products and procedures using outcome criteria such as end-of-course grades, "time to master," cost-benefit analyses, or sometimes by job performance indices. However, R&D funders react more favorably to research outcomes linked to warfighting capabilities and readiness impacts. Therefore, incorporating these criteria into MPT R&D is critical to future success. The Air Force Research Laboratory commissioned the present effort to determine the key measures used by Air Force decision-makers at the headquarters and major command levels. One way to target human performance improvement research is to focus on the <i>Measures of Effectiveness</i> (MOEs) used to evaluate the performance of weapon systems, organizational units, teams or crews, and individual airmen on operational tasks. Based on input from a wide variety of sources, the University of Dayton Research Institute (UDRI) developed a taxonomy of warfighting capability metrics linking the priorities and preferences of Air Force operational command decision makers for specific MOEs. Research findings included: (a) MOEs were numerous but not well documented or organized in the literature, (b) individual systems acquisition documents possess many MOEs, and (c) surrogate measures used for exercises and contests can also be useful. In addition to the MOE taxonomy, UDRI developed a hierarchical diagram of aircraft maintenance MOEs.				
14. SUBJECT TERMS  Aircraft, Aircrew, and Maintenance Personnel Performance; Availability; Combat Readiness; Crew Performance Measures; Human Factors; Job; Measures of Effectiveness (MOE), Measures of Performance (MOP), Measures of Merit (MOM); Metric; Taxonomy; Teams; Warfighting Capability; Training; Job, Team.			15. NUMBER OF PAGES 266	
			16. PRICE CODE	
17. SECURITY CLASSIFICATION OF REPORT UNCLASSIFIED	18. SECURITY CLASSIFICATION OF THIS PAGE UNCLASSIFIED	19. SECURITY CLASSIFICATION OF ABSTRACT UNCLASSIFIED	20. LIMITATION OF ABSTRACT  UNLIMITED	

**This page intentionally left blank.**

# CONTENTS

LIST OF FIGURES .....	vii
LIST OF TABLES .....	viii
PREFACE .....	ix
ACRONYMS .....	x
INTRODUCTION .....	1
Background .....	1
Overall Study Objective .....	2
Study Objective .....	3
APPROACH .....	3
Project Phase I .....	3
Project Phase II .....	4
Follow-on Study .....	4
Phase I Literature Search Method .....	4
Keywords .....	4
Subject Area Clusters .....	6
Databases Searched .....	7
Additional Sources .....	7
FINDINGS .....	7
1. United States Air Force Structure .....	8
Organization .....	8
Air Force Mission .....	8
Air Force Management .....	8
Field Organizations .....	9
MAJCOMs Functions .....	9
The Wing .....	9
Categories of Aircraft Systems .....	9
Airpower MAJCOMs and their Missions .....	11
Air Combat Command (ACC) .....	11
Air Mobility Command (AMC) .....	12
Air Force Special Operations Command (AFSOC) .....	12
Air Education and Training Command (AETC) .....	12
Air National Guard (ANG) .....	12
Air Force Reserve Command (AFRC) .....	13
United States Air Forces in Europe (USAFE) .....	13
Pacific Air Forces (PACAF) .....	13
Air Force Materiel Command (AFMC) .....	14
2. Mission-Oriented Tasks and Task Lists .....	14
Types of Mission Tasks .....	14
Mission Essential Task (MET) .....	14
Air Force Core Tasks .....	15
Types of Task Lists .....	16
Universal Task Lists (UTLs) .....	16
Mission Essential Task Lists (METL) .....	18
Uses of UTLs and METLs .....	20
3. MAJCOM-Level Performance Measurement .....	21
MAJCOM MOEs/MOPs .....	21
Mission Planning .....	21
Air Force Modernization Planning Process .....	23
Mission Area Assessment .....	23

Mission Needs Analysis.....	24
Mission Solution Analysis .....	25
Mission Area Plan.....	26
Functional Area Plan.....	27
4. Readiness Research and Reporting Systems for Decision Makers.....	28
Status of Resources and Training System.....	30
Air Force Integrated Readiness Measurement System (AFIRMS).....	32
Joint Service Readiness Measurement and Display Systems .....	33
Joint Readiness Automated Management System (JRAMS).....	33
Universal Joint Task List (UJTL) .....	33
Joint Automated Readiness System (JARS).....	33
Readiness Baseline (RBL) Indicators Project.....	33
Joint Readiness Assessment and Planning Integrated Decision System (JRAPIDS) .....	34
5. Evaluation Criteria .....	36
Defining Criteria .....	36
Effectiveness and Performance.....	36
MOEs and MOPs .....	36
Categories of MOEs/MOPs .....	37
6. Sources of MOEs and MOPs .....	42
Military Exercises .....	42
Wargames and Simulations.....	43
BATMAN & ROBIN.....	44
MARS .....	45
TAC BRAWLER.....	46
LCOM.....	46
Military Competitions .....	46
William Tell .....	47
Gunsmoke .....	49
Long Shot.....	50
RODEO.....	50
Tests and Evaluations .....	53
Operational Readiness Inspection (ORI) Criteria .....	55
Command Briefings .....	57
MIL-STD 1776A, Aircrew Station and Passenger Accommodations .....	58
AFI 10-602, Determining Logistics Support and Readiness Requirements .....	58
Unit Quality Maintenance Metrics.....	58
MAAs & MAPs .....	59
Acquisition Documents.....	59
Readiness Reporting Systems .....	59
Joint Mission Essential Task Lists (JMETL).....	59
AF Aircrew Evaluation Criteria Instructions .....	59
Surrogate Measures.....	60
Sample MOEs/MOPs.....	60
7. Aircraft Maintenance MOE/MOP Taxonomy .....	61
Organization of Maintenance MOEs/MOPs .....	61
Other Views of Aircraft Maintenance MOEs .....	62
Hierarchical View of MOEs/MOPs .....	63
8. Utilizing Maintenance MOEs/MOPs to Evaluate the Operational Effectiveness of Training.....	73
Mission Capable (MC) Rate as a Primary Measure of Operational Capability .....	73
Factors that Influence Operational Effectiveness .....	73
Measuring Changes In Operational Capability.....	74

Maintenance Data Collection (MDC) Issues .....	75
Difficulties in Assessing the Effect of Maintenance Variables on Sortie Production.....	75
9. Aircrew-System Performance Taxonomy.....	75
Considerations in Developing Aircrew MOE Taxonomy.....	76
Aircrew Taxonomy Organization .....	76
Air Combat Command Mission Area Plan Summary.....	80
ACC MAP Mission 1: Air Superiority .....	82
ACC MAP Mission 2: Global Attack .....	83
ACC MAP Mission 4: Combat Search And Rescue.....	83
ACC MAP Mission 5: Surveillance and Reconnaissance.....	83
Sources of Aircrew – System MOE/MOP Taxonomy.....	83
Limitations .....	85
Taxonomy Layout.....	86
SUMMARY AND CONCLUSIONS .....	87
Summary .....	87
Literature Search and Initial Findings (Phase I) .....	87
Constructing the Aeronautical System – Human Performance MOE/MOP Taxonomy and Hierarchy .....	87
Phase II Tasks .....	88
Follow-on Study Tasks .....	88
Conclusions.....	88
Conclusion 1: MOEs/MOPs Numerous and Not Well Documented in Literature .....	89
Conclusion 2: Aircraft Maintenance Versus Aircrew Taxonomies Differ.....	89
Conclusion 3: Aircraft Maintenance Hierarchical Structure Could Support Modeling.....	89
Conclusion 4: Aircrew Taxonomy Needs Additional Research .....	89
Conclusion 5: MOE/MOP Taxonomy Available for Application to Evaluate Mission-Oriented Training.....	89
RECOMMENDATIONS .....	89
Further Development of Aircrew Taxonomy Needed .....	90
Possible Testbeds .....	90
REFERENCES .....	91
APPENDIX A, Points of Contact at MAJCOMs.....	97
APPENDIX B, Aircraft Maintenance – System MOE/MOP Taxonomy .....	99
APPENDIX C, Aircraft System Maintenance/Supportability MOEs/MOPs.....	135
APPENDIX D, Comparison of MAJCOM and Air Staff Maintenance-related Metrics .....	140
APPENDIX E, MOEs/MOPs and SORTS .....	147
APPENDIX F, Sources of MOEs/MOPs.....	150
APPENDIX G, Aircrew-System MOE/MOP Taxonomy .....	154
ATTACHMENT 1, Air Combat Command FY96 Mission Area Plans (ACC MAPs) Recap Sheets.....	197
ATTACHMENT 2, MAJCOM Operational Readiness Inspection Criteria .....	225
ORI Criteria for ACC.....	226
Operational Readiness Inspection (ORI) Criteria (Pg. 42) .....	226
Section A - Chapter 2 - Initial Response.....	226
Section B – Fighter Aircraft Criteria.....	228
Section C – Bomber/Tanker Aircraft Criteria.....	228
Section A - Chapter 3 - Employment.....	228
Section B – Fighter Aircraft Criteria.....	231
Section C – Bomber Aircraft Criteria .....	233
Section D – Special Mission Aircraft Criteria .....	233
Section E – Theater Airlift Criteria.....	234
ORI Criteria for AMC.....	235

Operational Readiness Inspections (Pg. 15).....	235
ORI Criteria for AFSOC.....	242
Section E - Unit Employment (Chapter 6, Pg. 12).....	242
Section F - Combat Support (Pg. 22).....	247

## LIST OF FIGURES

FIGURE 1. Performance measurement hierarchy. ....	2
FIGURE 2. Breakdown of performance measurement hierarchy – example mission. ....	3
FIGURE 3. Universal Joint Task List (UJTL) Organization, Version 3.0.....	17
FIGURE 4. Air Force Task List (AFTL) (AFDD 1-1, 1998). ....	18
FIGURE 5. AFTL Generic Task Organization. ....	18
FIGURE 6. The relationship between the JMETL and the Joint Training System.....	19
FIGURE 7. AFTL and AFMETL during Planning Process (AFDD 1-1, 1998). ....	21
FIGURE 8. Mission Planning Hierarchy. ....	22
FIGURE 9. Strategy-to-Task. ....	24
FIGURE 10. Mission Area Assessment.....	25
FIGURE 11. Mission Needs Analysis (MNA) ....	26
FIGURE 12. Mission Solution Analysis.....	27
FIGURE 13. Mission Area Plan Process ....	28
FIGURE 14. Current readiness and sustainment assessment system ....	29
FIGURE 15. Chairman, Joint Chief of Staff’s view of readiness.....	32
FIGURE 16. JRAPIDS: A holistic method for determining future force capabilities.....	34
FIGURE 17. Standard wargame model showing components.....	44
FIGURE 18. Scenes from William Tell ‘96 - Maintenance Competition.....	48
FIGURE 19. Scenes from William Tell ‘96 - Loadeo competition. ....	49
FIGURE 20. Scenes from Long Shot ‘96. ....	50
FIGURE 21. Scenes from RODEO ‘96 - Flying Competition.....	51
FIGURE 22. Scenes from RODEO ‘96 - Non-Flying Competitions.....	52
FIGURE 23. OT&E Rating Hierarchy.....	56
FIGURE 24. Sample Breakdown of MOEs/MOPs.....	62
FIGURE 25. Utilization/Sortie generation rate hierarchy (overview diagram). ....	65
FIGURE 26. Utilization/Sortie generation rate hierarchy (top level). ....	66
FIGURE 27. Adjusted sortie schedule hierarchy.....	67
FIGURE 28. Total flyable rate hierarchy.....	68
FIGURE 29. Not mission capable rate hierarchy.....	69
FIGURE 30. Break rate hierarchy.....	70
FIGURE 31. Mean down time hierarchy.....	71
FIGURE 32. Mean down time hierarchy.....	72
FIGURE 33. Hierarchy of factors that influence operational effectiveness ....	74

## LIST OF TABLES

TABLE 1. US Air Force Field Organizations.....	10
TABLE 2. Air Missions .....	11
TABLE 3. Levels of War Definitions Addressed in UJTL and Service Task Lists .....	17
TABLE 4. Overall C-Level Rating and Corresponding Capability .....	30
TABLE 5. Readiness Indicators for the US Air Force.....	31
TABLE 6. Classification of Measures. ....	38
TABLE 7. Major Commands and Categories of Missions .....	39
TABLE 8. Test-Type Application Matrix.....	53
TABLE 9. Sample Surrogate Measures .....	60
TABLE 10. Sample Mission Effectiveness MOEs/MOPs.....	61
TABLE 11. Summary of AFTL structure. ....	77
TABLE 12. Aircrew-System Taxonomy Hierarchy. ....	77
TABLE 13. Air Combat Command Mission Area Plans (FY98) Executive Summary Listing .....	81
TABLE 14. Cross-reference from AFTL to ACC MAP.....	81
TABLE 15. Aircrew-System MOE/MOP Taxonomy (Sample). ....	86

## PREFACE

This effort was conducted under Work Unit 1123-A2-20, INNTECH – R&D in Integrated Training Technologies. The Air Force Research Laboratory, Warfighter Training Research Division (AFRL/HEA) technical monitor was Dr Winston Bennett, Jr.

This report documents work performed to identify *Criteria for Evaluating Aircrew and Maintainer Warfighter Performance in Aeronautical Systems Using Measures of Effectiveness*, conducted by the University of Dayton Research Institute (UDRI) Human Factors Group under two contracts. During the period 1995-1998, UDRI performed work on this project while operating the Crew System Ergonomics Information Analysis Center (CSERIAC), and during the period September 1998-April 1999, UDRI performed work on this project under a subcontract with Metrica, Incorporated. This 3-year project was performed initially for the Air Force Armstrong Laboratory's Human Resources Directorate, Cognition and Performance Division, located at Brooks AFB, TX and then for the Air Force Research Laboratory Human Effectiveness Directorate, Warfighter Training Research Division (AFRL/HEA), located at Mesa, AZ. CSERIAC is a Department of Defense (DoD) Information Analysis Center sponsored by the Defense Technical Information Center (DTIC), technically managed by the Air Force Research Laboratory Crew Interface Division and operated by UDRI from 1987-1998. The CSERIAC part of the work was conducted under DoD Contract Number SPO900-94-D-0001, and the remaining portion was conducted under prime contract F41624-97-5030 with Metrica, Incorporated and their subcontract to UDRI, 4050-003-01.

The Senior Technical Analyst and Project Manager for this study was Frank C. Gentner. Paul Cunningham assisted in developing the maintenance measures of effectiveness (MOE) hierarchy and MOE taxonomy. Dr Ron Schopper of CSERIAC-UDRI provided technical advice. Scot Best was the primary human factors analyst during most of this period. Jason Morris of CSERIAC assisted with the completion of this report after Scot Best's departure. Terrence Tiller assisted in updating and expanding the Aircrew MOE Taxonomy. Dr Winston Bennett (AFRL/HEA) provided continuing sponsorship, advice, support, and technical insight.

Special thanks to the numerous Air Staff, Major Command, and Air Force Operational Test and Evaluation Center (AFOTEC) staffers who furnished Air Force and command information not available through the DTIC system. Thanks to Major Dorothy Tribble of the AF Logistics Management Agency (AFLMA) who reviewed the logistics portion of the MOE/MOP taxonomy. Also, thanks to Dr Bennett for his reviews and comments on this effort. Finally, thanks to the personnel at the University of Dayton Technical Information Services Office (TISO) for their support and cooperation in the compilation of literature search material.

## ACRONYMS

<u><b>A</b></u>			
<b>AAA</b>	Anti-Air Artillery	<b>AMCPAM</b>	Air Mobility Command Pamphlet
<b>AAW</b>	Anti-Air Warfare	<b>AMCI</b>	Air Mobility Command Instruction
<b>AB</b>	Air Base	<b>AMMP</b>	Air Mobility Master Plan
<b>ABDR</b>	Aircraft Battle Damage Repair	<b>AMOG</b>	Air Mobility Operations Group
<b>ABDRT</b>	Aircraft Battle Damage Repair Time	<b>ANG</b>	Air National Guard
<b>AC</b>	Air Controller	<b>ANGRC</b>	Air National Guard Readiness Center
<b>ACC</b>	Air Combat Command	<b>AOC</b>	Air Operations Center
<b>AE</b>	Aeromedical Evacuation	<b>AOR</b>	Area of Responsibility
<b>AEF</b>	Aerospace Expeditionary Force	<b>APH</b>	Aircraft Possessed Hours
<b>AETC</b>	Air Education and Training Command	<b>ASC</b>	Aeronautical Systems Center
<b>AF</b>	United States Air Force	<b>ASD</b>	Average Sortie Duration
<b>AFB</b>	Air Force Base	<b>ASUW</b>	Anti-Surface Warfare
<b>AFDC</b>	Air Force Doctrine Command	<b>ASW</b>	Anti-Submarine Warfare
<b>AFDD</b>	Air Force Doctrine Document	<b>ATO</b>	Air Tasking Order
<b>AFFTC</b>	Air Force Flight Test Center	<b>AWACS</b>	Airborne Warning and Control System
<b>AFI</b>	Air Force Instruction	<b>AWM</b>	Awaiting Maintenance
<b>AFIRMS</b>	Air Force Integrated Readiness Measurement System	<b>AWP</b>	Awaiting Parts
<b>AFMC</b>	Air Force Material Command	<u><b>B</b></u>	
<b>AFMP</b>	Air Force Modernization Planning	<b>BAI</b>	Back-up Aircraft Inventory
<b>AFMSS</b>	Air Force Mission Support System	<b>BATMAN</b>	Battle-Management Assessment System
<b>AFNS</b>	Air Force News Service	<b>BDF</b>	Bomber Defense Factor
<b>AFOTEC</b>	Air Force Operational Test and Evaluation Center	<b>BLOS</b>	Beyond Line of Site
<b>AFPD</b>	Air Force Policy Directive	<b>BVR</b>	Beyond Visual Range
<b>AFRC</b>	Air Force Reserve Command	<u><b>C</b></u>	
<b>AFRES</b>	Air Force Reserve	<b>C<sup>2</sup></b>	Command and Control
<b>AFSOC</b>	Air Force Special Operations Command	<b>C<sup>4</sup></b>	Command, Control, Communications, and Computers
<b>AFSOF</b>	Air Force Special Operations Forces	<b>C<sup>3</sup>I</b>	Command, Control, Communications, and Intelligence
<b>AFTL</b>	Air Force Task List	<b>C<sup>4</sup>I</b>	Command, Control, Communications, Computers, and Intelligence
<b>AGE</b>	Aerospace Ground Equipment	<b>CAMS</b>	Core Automated Maintenance System
<b>AI</b>	Air Interdiction	<b>CAS</b>	Close Air Support
<b>AL/HRC</b>	Armstrong Laboratory, Human Resources Directorate, Cognition and Performance Directorate	<b>CAX</b>	Computer-Assisted Exercise
<b>AMC</b>	Air Mobility Command		
<b>AMCNS</b>	Air Mobility Command News		

<b>CEP</b>	Circular Error Probability
<b>CINC</b>	Commander-in-Chief
<b>C-Level</b>	Category Level
<b>CM</b>	Corrective Maintenance
<b>CND</b>	Cannot Duplicate
<b>COA</b>	Course of Action
<b>COEA</b>	Cost and Operational Effectiveness Analysis
<b>COI</b>	Critical Operational Issues
<b>CONOPS</b>	Concepts of Operations
<b>CMUP</b>	Conventional Mission Upgrade Program
<b>CSERIAC</b>	Crew System Ergonomics Information Analysis Center
<b>CTAPS</b>	Contingency Tactical Air Control System Automated Planning System
<b>CT</b>	Counterterrorism

## **D**

<b>DA</b>	Direct Action
<b>DAS</b>	Defensive Air
<b>DEA</b>	Drug Enforcement Agency
<b>DIS</b>	Distributed Interactive Simulation
<b>DMT</b>	Distributed Mission Training
<b>DoD</b>	Department of Defense
<b>DTIC</b>	Defense Technical Information Center

## **E**

<b>EADSIM</b>	Extended Air Defense Simulation
<b>EBO</b>	Expected Back Orders
<b>ECG</b>	Electrocardiogram
<b>ECM</b>	Electronic Countermeasures
<b>EEG</b>	Electroencephalograph
<b>EKG</b>	Electrocardiogram
<b>EPA</b>	Extended Planning Annex
<b>EPF</b>	Equipment Performance Factor
<b>ESAMS</b>	Enhanced Surface-to-Air Missile Simulation
<b>ESM</b>	Electronic Support Measures
<b>ESRT</b>	Essential System Repair Time
<b>EW</b>	Electronic Warfare

## **F**

<b>FAC</b>	Forward Air Controller
<b>FAP</b>	Functional Area Plan

<b>FEBA</b>	Forward Edge of the Battle Area
<b>FH</b>	Flight Hour
<b>FID</b>	Foreign International Defense
<b>FMC</b>	Fully Mission Capable
<b>FMEA</b>	Failure Modes and Effects Analysis
<b>FOD</b>	Foreign Object Damage
<b>FOT&amp;E</b>	Follow-on Operational Tests and Evaluations
<b>FSL</b>	Full System List
<b>FY</b>	Fiscal Year

## **G**

<b>GAO</b>	General Accounting Office
<b>GCCS</b>	Global Command and Control System
<b>GSORTS</b>	Global Status of Resources and Training System

## **H**

<b>HOF</b>	Health of the Force
<b>HQ</b>	Headquarters
<b>HRV</b>	Heart Rate Variability

## **I**

<b>IPF</b>	Inflight Performance Factor
<b>IG</b>	Inspector General
<b>IMPACTS</b>	Integrated Manpower, Personnel, and Comprehensive Training and Safety
<b>IOC</b>	Initial Operational Capability
<b>IOT&amp;E</b>	Initial Operational Tests and Evaluations
<b>IR/EO</b>	Infrared/Electro-Optical
<b>ITV</b>	In-Transit Visibility
<b>IW</b>	Information Warfare

## **J**

<b>JARS</b>	Joint Automated Readiness System
<b>JAST</b>	Joint Advanced Strike Technology Program
<b>JFCC</b>	Joint Forces Command & Control
<b>JMET</b>	Joint Mission Essential Task
<b>JMETL</b>	Joint Mission Essential Task Lists
<b>JRAMS</b>	Joint Readiness Automated Management System

**JRAPIDS** Joint Readiness Assessment and Planning Integrated Decision System  
**JTF** Joint Task Force

## **L**

**LAD** Latest Arrival Date at Port of Debarkation  
**LCOM** Logistics Composite Model  
**LOC** Lines of Communication  
**L-QPM** Logistics Quality Performance Measures  
**LRIP** Low Rate Initial Production  
**LRU** Line Replaceable Unit

## **M**

**M&S** Modeling and Simulation  
**MAA** Mission Area Assessment  
**MAJCOM** Major Command  
**MAP** Mission Area Plan  
**MARS** Multi-Warfare Assessment and Research System  
**MAST** MAP Analysis Support Team  
**MAT** Mission Area Team  
**MED EVAC** Medical Evacuation  
**MC** Mission Capable  
**MCH** Modified Cooper-Harper Scale  
**MDT** Mean Downtime  
**MIL-STD** Military Standard  
**MIW** Mine Warfare  
**MMH/FH** Maintenance Man-Hours per Flying Hour  
**MMH/LU** Maintenance Man-Hours per Life Unit  
**MNA** Mission Needs Analysis  
**MNS** Mission Needs Statement  
**MOC** Maintenance Operation Center  
**MOE** Measures of Effectiveness  
**MOM** Measures of Merit  
**MOP** Measures of Performance  
**MPP** Modernization Planning Process  
**MPT** Manpower, Personnel, and Training  
**MP/U** Maintenance Personnel per Operational Unit  
**MRC** Major Regional Conflict  
**MRT** Mean Repair Time

**MS** Mile Stone  
**MSRT** Mean Supply Response Time  
**MTBCF** Mean Time Between Critical Failure  
**MTBD** Mean Time Between Demand  
**MTBDE** Mean Time Between Downing Event  
**MTBM** Mean Time Between Maintenance  
**MTBMA** Mean Time Between Maintenance Actions  
**MTBR** Mean Time Between Removal  
**MLDT** Mean Logistics Delay Time  
**MTM/D** Million Ton Miles per Day  
**Mx** Maintenance

## **N**

**NAF** Numbered Air Force  
**NASA** National Aeronautics and Space Administration  
**NBC** Nuclear, Biological, and Chemical  
**NCA** National Command Authority  
**NMC** Not Mission Capable  
**NMCA** Not Mission Capable Airworthy  
**NMCB** Not Mission Capable Both  
**NMCBA** Not Mission Capable Both Airworthy  
**NMCBS** Not Mission Capable Both Scheduled  
**NMCBU** Not Mission Capable Both Unscheduled  
**NMCBSA** Not Mission Capable Both Scheduled Airworthy  
**NMCBUA** Not Mission Capable Both Unscheduled Airworthy  
**NMCM** Not Mission Capable Maintenance  
**NMCMA** Not Mission Capable Maintenance Airworthy  
**NMCMS** Not Mission Capable Maintenance Scheduled  
**NMCMU** Not Mission Capable Maintenance Unscheduled  
**NMCMSA** Not Mission Capable Maintenance Scheduled Airworthy  
**NMCMU** Not Mission Capable Maintenance Unscheduled Airworthy

**NMCS** Not Mission Capable Supply  
**NMCSA** Not Mission Capable Supply  
 Airworthy  
**NORAD** North American Aerospace  
 Defense Command  
**NORM** Not Operationally Ready -  
 Maintenance  
**NORM-F** Not Operationally Ready -  
 Maintenance - Flying  
**NORM-G** Not Operationally Ready -  
 Maintenance - Ground  
**NORS** Not Operationally Ready - Supply  
**NORS-F** Not Operationally Ready - Supply  
 - Flying  
**NORS-G** Not Operationally Ready - Supply  
 - Ground  
**NRTS** Not Repairable This Station  
**NSIAD** National Security and  
 International Affairs Division

## **Q**

**O&M** Operations and Maintenance  
**OAS** Offensive Air  
**OCI** Offensive Counter Information  
**OPR** Office of Primary Responsibility  
**Ops** Operations  
**OPTEMPO** Operating Tempo  
**OR** Operationally Ready  
**ORI** Operational Readiness Inspection  
**ORD** Occupational Requirements  
 Document  
**OT&E** Operational Tests and Evaluations

## **P**

**PA** Public Affairs  
**PACAF** Pacific Air Forces  
**PAF** Penetration Altitude Factor  
**PEMD** Program Evaluation and  
 Methodology Division  
**PERSTEMPO** Personnel Tempo  
**PET** Positron Emission Tomography  
**PH** Possessed Hours  
**Pk** Probability of Kill  
**PM** Preventive Maintenance  
**PMC** Partially Mission Capable  
**PMCB** Partially Mission Capable Both  
**PMCM** Partially Mission Capable

**PMCS** Partially Mission Capable Supply  
**PPBS** Planning, Programming, and  
 Budgeting System  
**Ps** Probability of Survival  
**PSYOP** Psychological Operations  
**PTP** Probability to Penetrate

## **Q**

**QA** Quality Assurance  
**QAFA** Quality Air Force Assessments  
**QOT&E** Qualification Operational Tests  
 and Evaluations  
**QPM** Quality Performance Measures

## **R**

**R&D** Research and Development  
**RBL** Readiness Baseline  
**RCBF** Regional Cerebral Blood Flow  
**RCM** Requirements Correlation Matrix  
**RD&A** Research, Development, and  
 Acquisition  
**RF** Radio Frequency  
**RMC** Reduced Material Condition  
**ROBIN** Raid Originator Bogie Ingress  
**ROI** Return on Investment  
**RTOK** Retest Okay

## **S**

**SA** Situational Awareness  
**SAF** Secretary of the Air Force  
**SAG** Surface Action Group  
**SAGAT** Situational Awareness Global  
 Assessment Technique  
**SA/I** Strategic Attack/Interdiction  
**SAM** Surface-to-Air Missile  
**SE** Support Equipment  
**SECAF** Secretary of the Air Force  
**SEMR** Sustainment Executive  
 Management Report  
**SIOP** Single Integrated Operational Plan  
**SO** Special Operations  
**SOAR** State of the Art Report  
**SOF** Special Operations Forces  
**SORTS** Status of Resources and Training  
 System  
**Sqdn** Squadron

**SR** Special Reconnaissance  
**STW** Strike Warfare  
**SURVIAC** Survivability and Vulnerability  
Information Analysis Center  
**SWAT** Strategic Workload Assessment  
Technique

## **T**

**T&E** Test and Evaluation  
**TAC** Tactical Air Combat  
**TACC** Tanker Airlift Control Center  
**TBM** Theater Battle Management  
**TEMP** Test and Evaluation Master Plan  
**TF** Total Flyable  
**THAF** Threat Avoidance Factor  
**TMD** Theater Missile Defense  
**TNMC** Total Not Mission Capable  
**TNMCA** Total Not Mission Capable  
Airworthy  
**TNMCS** Total Not Mission Capable  
Supply  
**TNMCM** Total Not Mission Capable  
Maintenance  
**TO** Technical Order  
**TOT** Time-over-Target  
**TPIPT** Technical Planning Integrated  
Product Team  
**TPMCS** Total Partial Mission Capable  
Supply  
**TPMCM** Total Partial Mission Capable

**TISO** Maintenance  
Technical Information Services  
Office

## **U**

**UDRI** University of Dayton Research  
Institute  
**UJTL** Universal Joint Task List  
**ULN** Unit Line Number  
**UNTL** Universal Naval Task List  
**URG** Underway Replenishment Group  
**USAF** United States Air Force  
**USAFE** United States Air Forces in  
Europe  
**USNGB** United States National Guard  
Bureau  
**UTC** Unit Type Code  
**UTE** Utilization  
**UW** Unconventional Warfare

## **W**

**WCCS** Wing Command and Control  
System  
**WD** Weapons Director  
**WPAFB** Wright-Patterson Air Force Base  
**WPC** Warrior Preparation Center  
**WSR** Weapon System Reliability

# **EVALUATING AIRCREW AND MAINTAINER WARFIGHTER PERFORMANCE IN AERONAUTICAL SYSTEMS USING MISSION-ORIENTED MEASURES OF EFFECTIVENESS**

## **INTRODUCTION**

### **Background**

Personnel and training research and development (R&D) has traditionally validated its products and procedures using outcome criteria such as final course grade, performance on the job, time to reach task mastery, or cost to develop and use versus benefits received. Major program and budget decisions are generally made by high-level officers and civilians who focus on such things as force structure, weapon systems, theaters of operation, readiness, and war-fighting capabilities. Once major budgets and programs are approved, decisions regarding the specific projects to be conducted within a program, and the allocation of the resources to those specific projects are made at the Directorate and Division level, where the decision-makers usually appreciate the value of the traditional criteria such as reduced training time for a given proficiency level, manpower reductions, or changes in aptitude requirements. Therefore, identifying and incorporating relevant readiness and war-fighting criteria into Manpower, Personnel, and Training (MPT) R&D program descriptions and impact statements are critical. The current issue is that research scientists do not readily know what these criteria are or where and how to get measures of them (Gould, 1995).

For the first time in many years, Department of Defense (DoD) MPT R&D budgets are being reduced and the trend is scheduled to continue. Those making budget decisions have not clearly seen payoffs in human systems R&D in terms of what they see as “bang-for-the-buck,” i.e., war-fighting capability. The Services claim their MPT R&D technologies can reduce cost while increasing combat readiness and performance. For the most part, however, MPT R&D technologies have not demonstrated their viability in terms that unit, Major Command (MAJCOM), and management can clearly see as related to war-fighting requirements. Therefore, decision-makers use the absence of evidence for Return on Investment (ROI) as an indication of the lack of merit of MPT R&D. Unless a link between MPT effectiveness measures and higher level war-fighting Measures of Effectiveness (MOEs) is established, it is feared that MPT R&D budgets will continue to be reduced in the out years (Gould, 1995).

Few MPT resources are devoted to evaluate the relative effectiveness of proposed R&D solutions in terms that top management will accept. In fact, few scientists are aware of what these top decision-makers and potential users will accept as indicators of merit, especially not in terms of criteria that MPT research products can truly and measurably influence. Nor are they fully aware of whom they should target for a demonstration of the existence of an MPT R&D and wartime performance link. That is, the scientists do not know the identity and interests of authorities who would, in turn, convince the top decision-makers of the true return on human systems R&D investments.

Military training is a major component of the military budget, making a large and continuing demand on resources allocated to the military services (Orlansky, String, & Chatelier, 1982). Operational readiness depends on effective training. To improve the readiness and expertise of aircrews, the Air Force (AF) needs effective, low-cost training tools. One way to attain cost-effective training may be to focus on the MOEs and Measures of Performance (MOPs) used to evaluate the performance of weapon systems, organizational units, and individual airmen.

When viewed in a hierarchy (see Figure 1), the most important level to start investigating MOEs and MOPs is the mission-effectiveness level. As defined in Air Force Instruction (AFI) 10-

602, *Determining Logistics Support and Readiness Requirements* (AFI 10-602, 1994), mission effectiveness is the probability that a system is available to initiate its mission and will complete its mission when initiated. The calculation takes into account both the system's availability at the mission start and its reliability and dependability during a specified mission. At the mission effectiveness level, one can gain a broad view of mission goals and any subsequent underlying tasks involved to obtain that goal (Dalrymple, 1996). Figure 2 depicts an example of a mission, as detailed in various MOEs, working down the hierarchy in Figure 1.

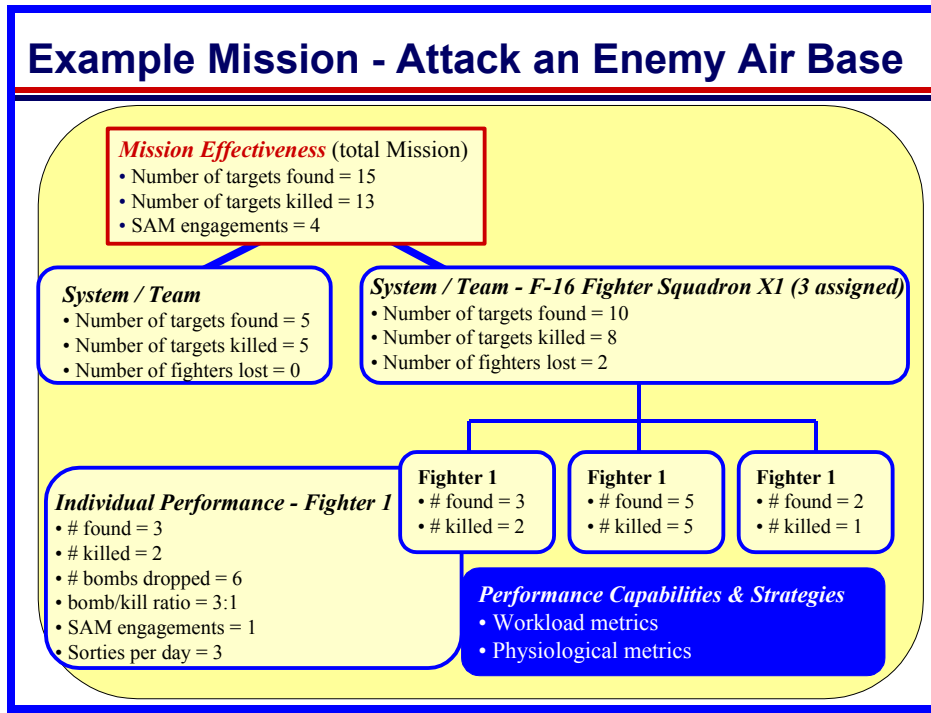


**FIGURE 1. Performance measurement hierarchy.**  
(Adapted from Dalrymple, 1996)

This breakdown shows the various levels of a mission in which MOEs and MOPs can be defined. Despite the detailed amount of information revealed in the lower levels of the hierarchy, most evaluators are concerned with the overall effectiveness with which the system accomplishes its mission (Dalrymple, 1996; JAST, 1995).

## Overall Study Objective

The objective of the *Criteria for Evaluating Human Systems Technology Effects on War-Fighting Capabilities* project, to which this study contributes, is to first identify the organizations, offices, and points of contact who have war-time missions and responsibilities. This is to be done through a literature search and preliminary phone contacts. The next objective is to work with those points-of-contact to capture criteria they will accept as being indicative of war-fighting capabilities. Then, using this report and the information gathered through selected interviews, the final objective is to develop a taxonomy or hierarchy of criterion measures by showing the hierarchical relationships of the criteria through decomposing and operationally defining each measure. The decomposition continues until either of two conditions is encountered. Either the criteria have no major human system implications (e.g., bomber and fighter operating range and airlift tonnage capability) or the criteria decompose to the point where the MPT links appear probable (e.g., measures of maximum possible sortie rate, line replaceable units (LRUs) incorrectly diagnosed as faulty and returned to depot, and critical satellite data not properly interpreted).



**FIGURE 2. Breakdown of performance measurement hierarchy – example mission.**

## Study Objective

This CSERIAC-UDRI study focused on identification of background material on MOEs/MOPs important to the evaluation of the AF aircraft-related missions' effectiveness. MOEs/MOPs that related to aircraft mission, systems, and maintenance were identified and their effects were related to overall mission effectiveness. In addition, this report identified MOEs/MOPs that could also be related to human performance. While the focus was on existing AF MOEs/MOPs, background information and MOEs/MOPs which might assist in identifying potential AF aircraft-related MOEs/MOPs was sought from all branches of the US military and other available sources. In addition to identifying MOEs/MOPs, this study provided background information on the AF and flying MAJCOMs' missions, readiness research, reporting systems, and other sources of MOEs/MOPs, such as exercises, wargames and simulations, competitions, operational tests and evaluations, operational readiness inspections, recent command briefings, and any surrogate measures accepted by commanders as proof of the likelihood that mission objectives would be accomplished. MOEs/MOPs were extracted from professional papers, standards, official documents, briefings, exercises, wargames/simulations, competition criteria, system acquisition documents, and inspection criteria developed by the military, industry, and academia.

## APPROACH

CSERIAC-UDRI accomplished the objectives in the following two phases:

### Project Phase I

Phase I tasks included the following:

- Surveyed the literature and network with experts on aircraft-related MOEs/MOPs;
- Developed a candidate listing of AF operational flying command officials responsible for wartime missions and identify MOEs/MOPs;

- Based on the literature search and networking findings, develop a consolidated taxonomy of MOEs/MOPs for aircraft systems, aircrew and maintenance, and
- Displayed these MOEs/MOPs together with their meaning, computational formula, and source, and
- Documented the findings in a technical report.

## Project Phase II

Phase II tasks included the following:

- Based on the findings in Phase I, identify official documents that indicate MAJCOM leadership preferred MOEs/MOPs and their priority from MAJCOM decision-makers;
- Refined a taxonomy of these MOEs/MOPs showing hierarchical relationships of the criteria of war-fighting capability through decomposing those criteria associated with human systems implications.

## Follow-on Study

In a follow-on study, UDRI

- Expanded coverage of aircrew MOEs/MOPs;
- Separated the aircrew portion of the taxonomy from the system and maintenance portions;
- Focused on efforts to identify aircrew metrics for use in the Distributed Mission Training (DMT) environment; and
- Used the A/OA-10, F-16, F-15C, and F-15E as prototype aircraft to explore in depth.

## Phase I Literature Search Method

CSERIAC-UDRI conducted an extensive search of government and commercial databases for literature related to MOEs, MOPs, and war-fighting capabilities. The search strategies associated with the results from each database search indicate the depth and breadth of the search. The following sections show the comprehensive search keyword and subject area listings.

### Keywords

Below is the keyword list submitted as part of the background literature search for relevant research.

- |   |   |
|---|---|
| • after action reviews  | • Core Automated Maintenance System (CAMS)                          |
| • aircraft maintenance & performance measures                           | • cannot duplicate (CND)  |
| • aircraft readiness  | • combat effectiveness (measures of, data sources)                  |
| • aircraft systems (measures of effectiveness)                          | • combat performance measures                                       |
| • airman retention rates  | • combat readiness  |
| • aptitude tests  | • contingency training  |
| • Armed Services Vocational Aptitude Battery (ASVAB) (AF correlates of) | • cost effectiveness of training, aptitude screening                |
| • ASVAB and job performance   | • cost models   |
| • average delivery time   | • criterion referenced tests / testing                              |
| • Availability (of aircraft)  | • critical incidents  |
| • bang-for-the-buck   | • critical tasks (selection of, training of, measurement, priority) |
| • bombs on target   |   |

- critique of battles
- debriefings
- faulty removals (in aircraft maintenance)
- force structure (measures of effectiveness)
- hierarchy of measures
- high driver(s)
- Inspector General (IG) Complaints
- in-commission rate (fully mission capable, partially mission capable rate)
- Influences on combat effectiveness
- Inspections (IG, inspections, audits, reports)
- job analysis
- Job Performance Measurement System (JAMS)
- Job Proficiency Guides
- job proficiency ratings
- jobs
- life cycle cost (life-cycle cost) (methods of reducing, measurements of)
- maintenance analysis indicators, metrics
- maintenance effectiveness
- maintenance man-hours per flying hour
- maintenance man-hours per sortie
- manpower
- measurement
- measurement and evaluation
- measurement and evaluation of technical training, maintenance training, electronics training
- measures of effectiveness (MOEs)
- measures of merit
- military personnel, civilian personnel, personnel, Air Force personnel,
- mishaps (accidents, injuries, fatalities)
- mission accomplishment
- Not Mission Capable (NMC) (maintenance, supply)
- Not Repairable This Station (NRTS)
- On-the-Job Training (measures)
- operational effectiveness
- operational readiness (rates, measures, reports)
- Operational Readiness Inspection (ORI) scores
- organizational assessment (methods)
- percent demand met
- performance appraisal, performance measures
- performance tests
- performance (human)
- productive capacity
- productivity
- proficiency
- quality control
- quality indicators, metrics
- ratings
- readiness
- recruiting
- Reliability Information Management System (REIMS)
- repeat write-ups
- selection
- sortie rate
- standards, setting standards
- statistics, correlation, factor analysis, analysis of the variance (associated with training, job performance, etc.)
- task time
- taxonomy of measures of effectiveness
- technology transfer
- test and evaluation
- time to perform
- time to proficiency
- total quality management (metrics)
- trade-off analysis
- training metrics
- training, Air Force training
- transfer of training
- unable to duplicate (in aircraft maintenance)
- utility
- validation of job performance measures
- value of work, value of technology
- vocational education, training,
- Walk Through Performance Tests (WTPT)
- war-fighting capability (ies)
- war-time capability (ies)
- work sample

## Subject Area Clusters

This sections details the topic area cluster strategy used for the literature search.

- **Measures of Effectiveness/Operational Effectiveness for Readiness, Mission Effectiveness**

Air Force Reserve (readiness)	technical training, maintenance
Air National Guard (readiness)	training, electronics training
aircraft maintenance & performance measures	measures of effectiveness (MOEs)
aircraft mission & performance measures	measures of merit
aircraft systems (measures of effectiveness)	measures of performance (MOPs)
combat readiness	mission effectiveness
combat effectiveness (measures of, data sources)	operational effectiveness
maintenance effectiveness	operational readiness (rates, measures, reports)
measurement and evaluation	readiness
measurement and evaluation of	training effectiveness
	war-fighting capability(ies)
	war-time capability(ies)
- **Combat Effectiveness Measures (in Research and Defense Media) – what decision-makers are willing to accept as proof of effectiveness**

bang-for-the-buck	fratricide
bombs on target	exchange rate
collateral damage	injury to or death of American personnel
combat effectiveness (measures of, data sources)	influences on combat effectiveness
combat performance measures	kills / kill ratio
combat readiness	sortie rate
debriefings	skill retention / decay
	utilization rate
- **Aircraft Maintenance Measures**

aircraft availability	sortie rate
aircraft readiness	task time
Core Automated Maintenance System (CAMS)	
cannot duplicate (CND)	
faulty removal of LRUs, etc.	
high drivers	
maintenance analysis indicators	
maintenance effectiveness	
maintenance man hours per flying hour	
maintenance man hours per sortie	
maintenance manpower requirements	
mishaps (maintenance induced)	
Not Mission Capable (NMC) rate (maintenance, supply)	
Not Repairable This Station (NRTS)	
percent demand met	
quality control indicators	

## Databases Searched

The search for bibliographic information regarding MOEs & MOPs contains citations and abstracts from the following government and commercial databases:<sup>1</sup>

### Non-Copyrighted:

- Defense Technical Information Center (DTIC) - Technical Report (TR)
- DTIC - Work Unit Summaries (WUIS)
- DTIC CD-ROM
- MATRIS

### Copyrighted:

- NASA - RECON
- National Technical Information Service (NTIS)
- IAC Aerospace
- Dissertation Abstracts Online
- Air University (AU) Press
- McGraw-Hill Publications

## **Additional Sources**

Extensive networking with DoD personnel was necessary to obtain official documents and briefings not available through the DTIC system. AF MAJCOM Inspector General, Standard Evaluation, Studies and Analysis, Plans, and other offices with aeronautical responsibilities were contacted and their MOEs/MOPs were examined. Contacts were also made to obtain AF instructions, manuals, doctrines, mission directives, Mission Areas Plans (MAPs), and command-level briefing on readiness-related metrics. Finally, military Internet sites were examined and follow-up calls and e-mails were used to track down additional MOEs/MOPs.

## **FINDINGS**

This section of the report sets forth the information gathered during the course of the study. The study was to identify Air Force operational flying organizations responsible for wartime missions. To this end we have include a section that identifies all Air Force major commands (MAJCOMs) and provides a narrative on the functions they perform as well as an explanation of the strategy-to-task process the Air Force uses to develop requirements for the commands. We have also presented a synopsis of the methods and measures the Air Force uses to assess the readiness of the force and a list, compiled by CSERIAC-UDRI, of important AF MOEs/MOPs is provided with definitions and references to other works on MOEs/MOPs. Additionally results from studies on human performance related to these MOEs/MOPs were listed and discussed. Hierarchies developed by CSERIAC-UDRI showing the measures relevant to aircraft maintenance are also provided.

Listed below is an index of the information that will follow:

1. Structure of the AF, including the missions of each MAJCOM
2. Mission-oriented tasks
3. MAJCOM-Level Performance Measures
4. Readiness Research and Reporting Systems
5. Evaluation Criteria
6. Sources of MOEs and MOPs

---

<sup>1</sup> Database search results are contained in the accompanying reports *Evaluating War-Fighting Capabilities of Aircraft Systems, Aircrew, and Maintenance Using Measures of Effectiveness and Performance, Volumes II & III. Literature Search Results.*

- (a) Exercises
  - (b) Wargames/Simulations
  - (c) Military Competitions
  - (d) Operational Test and Evaluation
  - (e) Operational Readiness Inspection Criteria
  - (f) Command Briefings
  - (g) MIL-STDs and Regulations
  - (h) Mission Area Analyses and Mission Area Plans
  - (i) Acquisition Documents
  - (j) Readiness Reporting Systems
  - (k) Joint and Service Mission Essential Task List efforts
  - (l) Related Surrogate Measures
7. Aircraft Maintenance MOE/MOP Taxonomy and Hierarchy
  8. Utilizing Maintenance MOEs/MOPs to Evaluate the Operational Effectiveness of Training
  9. Aircrew MOE/MOP Taxonomy

## 1. United States Air Force Structure

### **Organization**

To understand how commanders measure performance, one must understand the mission and organization of the AF. Currently, AF resources include 9 MAJCOMs, 32 field operating agencies, 6 direct reporting units, 81 major installations in the US and overseas, and more than 750,000 active-duty, Air National Guard (ANG), Air Force Reserve (AFRES), and civilian personnel. Each MAJCOM contributes to the overall mission of the AF. For the purpose of this report, we have concentrated on the three combat flying MAJCOMs: Air Combat Command (ACC), Air Mobility Command (AMC), and Air Force Special Operations Command (AFSOC), and examined documents from United States Air Forces in Europe (USAFE), Pacific Air Forces (PACAF), Air Force Materiel Command (AFMC), Air Education and Training Command (AETC), Air Force Reserve Command (AFRC), and Air National Guard (ANG).

### **Air Force Mission**



The mission of the AF is to defend the United States through control and exploitation of air and space (USAF Fact Sheet, 1997b). Teamed with the Army, Navy, and Marine Corps, the AF is prepared to fight and win any war if deterrence fails. The AF is responsible for providing:

- Aircraft and missile forces necessary to prevent or fight a general war.
  - Land-based air forces needed to establish air superiority, interdict the enemy, and provide air support of ground forces in combat.
- The primary aerospace forces for the defense of the US against air and missile attack.
  - The primary airlift capability for use by all of the nation's military services.
  - Major space research and development support for the DoD.
  - Assistance to the National Aeronautics and Space Administration (NASA) in conducting our nation's space program. (USAF Fact Sheet, 1997b.)

### **Air Force Management**

To ensure unit preparedness and overall effectiveness of the AF, the Secretary of the Air Force (SAF) is responsible for and has the authority to conduct all affairs of the Department of the AF (USAF Fact Sheet, 1997b). This includes training, operations, administration, logistical support and maintenance, and welfare of personnel. The Secretary's responsibilities include research and development, and any other activity prescribed by the President or the Secretary of Defense.

## ***Field Organizations***

The 9 MAJCOMs, 32 field operating agencies, 6 direct reporting units and their subordinate elements (see Table 1) constitute the field organizations that carry out the AF mission. In addition, there are two reserve components, the AFRES and the ANG. For the purposes of this report, only those MAJCOMs concerned with providing airpower will be discussed.

### ***MAJCOMs Functions***

MAJCOMs are organized on a functional basis in the United States and a geographic basis overseas. They organize, administer, equip, and train their subordinate elements for the accomplishment of assigned missions. MAJCOMs generally are assigned specific responsibilities based on functions. Elements of MAJCOMs include numbered air forces, wings, groups, squadrons, and flights.

### ***The Wing***

The basic unit for generating and employing combat capability is the wing, which has always been the AF's prime war-fighting instrument. Composite wings operate more than one kind of aircraft, and may be configured as self-contained units designated for quick air intervention anywhere in the world. Other wings continue to operate a single aircraft type ready to join air campaigns anywhere they are needed. Air base and specialized mission wings such as training, intelligence, and test also support the AF mission. Within the wing, operations, logistics, and support groups are the cornerstones of the organization.

### ***Categories of Aircraft Systems***

Two major subclasses of aircraft are used: Fighting and Transport/Payload (Conwell, 1995).

Fighting aircraft are divided into (and symbolized by) the following: Attack (A-), Fighter (F-), Bomber (B-), Electronic Warfare (EW-, E-), Command and Control (C<sup>2</sup>; E-, EC-), Reconnaissance (RC-), and Anti-Submarine Warfare (ASW; P-, S-).

The Transport/Payload subclass consists of aircraft supporting the functional mission areas of Supply (C-), Aeromedical Evacuation (C-), Personnel, Special Operations (Ops; MC-), Combat Rescue, and Air Refueling (KC-).

Table 2 shows various air mission areas and the aircraft delegated for those missions.

**TABLE 1. US Air Force Field Organizations**

***Major Commands (MAJCOMs)***

- Air Combat Command (ACC), Langley AFB, VA
- Air Education and Training Command (AETC), Randolph AFB, TX
- AF Materiel Command (AFMC), Wright-Patterson AFB, OH
- AF Space Command (AFSPACECOM), Peterson AFB, CO
- AF Special Operations Command (AFSOC), Hurlburt Field, FL
- Air Mobility Command (AMC), Scott AFB, IL
- AF Reserve Command (AFRC), Robins AFB, GA
- Pacific Air Forces (PACAF), Hickam AFB, HI
- United States Air Forces in Europe (USAFE), Ramstein AB, Germany

***Field Operating Agencies***

- AF Agency for Modeling and Simulation, Orlando, FL
- AF Audit Agency, Washington, D.C.
- AF Base Conversion Agency, Arlington, VA
- AF Center for Environmental Excellence, Brooks AFB, TX
- AF Center for Quality and Management Innovation, Randolph AFB, TX
- AF Civil Engineer Support Agency, Tyndall AFB, FL
- AF Cost Analysis Agency, Arlington, VA
- AF Flight Standards Agency, Andrews AFB, MD
- AF Historical Research Agency, Maxwell AFB, AL
- AF History Support Office, Bolling AFB, Washington, D.C.
- AF Inspection Agency, Kirtland AFB, NM
- AF Legal Services Agency, Bolling AFB, Washington, D.C.
- AF Logistics Mgmt Agency, Maxwell AFB, Gunter Annex, AL
- AF Medical Operations Agency, Bolling AFB, Washington, D.C.
- AF Medical Support Agency, Brooks AFB, TX
- AF Natl Security Emergency Prep Agency, Brooks AFB TX

- AF News Agency, Kelly AFB, TX
- AF Office of Special Investigations, Bolling AFB, Wash, D.C.
- AF Operations Group, Washington, D.C.
- AF Personnel Center, Randolph AFB, TX
- AF Personnel Operations Agency, Washington, D.C.
- AF Program Executive Office, Washington, D.C.
- AF Real Estate Agency, Bolling AFB, Washington, D.C.
- AF Review Boards Agency, Washington, D.C.
- AF Safety Center, Kirtland AFB, NM
- AF Services Agency, Randolph AFB, TX
- AF Studies and Analyses Agency, Washington, D.C.
- AF Technical Applications Center, Patrick AFB, FL
- AF Weather Agency, Offutt AFB, NE
- Air Intelligence Agency, Kelly AFB, TX
- Air National Guard Readiness Center, Andrews AFB, MD
- Joint Services Survival, Evasion, Resistance and Escape Agency, Fort Belvoir, VA

***Direct Reporting Units***

- 11th Wing, Bolling AFB, Washington, D.C.
- AF Communications and Information Center, Washington, D.C.
- AF Doctrine Center, Maxwell AFB, AL
- AF Operational Test and Evaluation Center, Kirtland AFB, NM
- AF Security Forces Center, Lackland AFB, TX
- United States AF Academy, Colorado Springs, CO

***Unified Combatant Commands***

- US European Command, Stuttgart-Vaihingen, Germany
- US Pacific Command, Honolulu, HI
- US Atlantic Command, Norfolk, VA
- US Southern Command, Quarry Heights, Republic of Panama
- US Central Command, MacDill AFB, FL
- US Space Command, Peterson AFB, CO
- US Special Operations Command, MacDill AFB, FL
- US Transportation Command, Scott AFB, IL
- US Strategic Command, Offutt AFB, NE

Source: *Airman Magazine*, 1998

**TABLE 2. Air Missions**

Air Mission Areas	Command Headquarters	Command Element	Action Unit	Aircraft Systems
Offensive Air (OAS)	Numbered Air Force			F-15, F-16
Air Interdiction (AI)				F-15, F-117, F-16, B-52, B-1, B-2
Defensive Air (DAS)				F-16, F-15
Electronic Countermeasures (ECM)		Air Wing	Squadron	EC-130, F-15
Electronic Support Measures (ESM)				EC-130, JSTARS
Intratheater MEDEVAC				HS-3, H-3, CH-3, MH-53, UH-60
Intertheater MEDEVAC				C-9, C-21, C-26, C-141
Air Rescue				HS-3, H-3, CH-3, MH-53, UH-60
Command & Control (C <sup>2</sup> )				AWACS, ABCCC, E-3A
Reconnaissance				U-2
Refueling				KC-10, KC-135
Intratheater Airlift				C-130, C-141, C-9
Intertheater Airlift				CRAF, C-5, C-17, C-141

Source: From *Joint Warfare Simulation Object Library: Joint Warfare Taxonomy* (Conwell, 1995).

### ***Airpower MAJCOMs and their Missions***

As mentioned earlier, this report will focus on those AF MAJCOMs that provide airpower. Below are the missions of the relevant MAJCOMs. Points of contact at each MAJCOM are located in Appendix A.

#### ***Air Combat Command (ACC)***



*Mission:* ACC provides the “global power” arm of the “global reach-global power” Air Force vision and focuses on deterrence and air campaign operations. ACC’s force structure consists of fighters; bombers; command, control, communications and intelligence aircraft; reconnaissance aircraft; combat delivery aircraft; electronic warfare aircraft; and air rescue aircraft.

As a force provider, ACC organizes, trains, equips and maintains combat-ready forces for rapid deployment and employment while ensuring strategic air defense forces are ready to meet the challenges of peacetime air sovereignty and wartime air defense. ACC provides nuclear-capable forces for U.S. Strategic Command and theater air forces for the five geographic unified commands (U.S. Atlantic Command, U.S. European Command, U.S. Pacific Command, U.S. Central Command and U.S. Southern Command). ACC also provides air defense forces to the North American Aerospace Defense Command (NORAD). In addition, ACC operates certain air mobility forces in support of U.S. Transportation Command. ACC prepares combat air forces to globally implement national policy (USAF Fact Sheet, 1997a).

### **Air Mobility Command (AMC)**



*Mission:* AMC's mission is to provide airlift, air refueling, special air mission, and aeromedical evacuation for U.S. forces. AMC also supplies forces to theater commands to support wartime tasking. As the Air Force component of the United States Transportation Command, AMC is the single manager for air mobility (Air Mobility Command, 1998).

### **Air Force Special Operations Command (AFSOC)**



*Mission:* AFSOC is America's specialized air power. It is a step ahead in a changing world, delivering special operations combat power anytime, anywhere. The command is committed to continual improvement to provide Air Force special operations forces for worldwide deployment and assignment to regional unified commands to conduct: unconventional warfare; direct action; special reconnaissance; counter-proliferation; foreign internal defense; information and psychological operations; personnel recovery and counter-terrorism operations (USAF Fact Sheet, 1998).

### **Air Education and Training Command (AETC)**



*Mission:* AETC recruits new people into the U.S. Air Force and provides them with military, technical and flying training; and pre-commissioning, professional military and continuing education. After receiving basic training and prior to placement in Air Force jobs, enlisted people are trained in a technical skill. More than 1,350 active technical courses offer a wide variety of job skills for today's young adults. During their careers in the Air Force, every officer and enlisted person receives education and training administered by the command (USAF Fact Sheet, 1997b).

### **Air National Guard (ANG)**



*Mission:* Enforces federal authority, suppresses insurrection, and defends the nation when mobilized by the president, Congress, or both. Units augment the AF by participating in operations and exercises worldwide by direction of the Air Staff, major commands, or joint/unified commands. Commanded by the governors of the 50 states, Puerto Rico, Guam, the Virgin Islands, and the commanding general of the District of Columbia. Each governor is represented in the state or territory chain of command by an adjutant general (Airman, 1998). The purpose of each Guard component is to provide trained

units and qualified persons available for active duty in the armed forces, in time of war or national emergency, and at such other times as the national security requires, to fill the needs of the armed forces whenever, during, and after the period needed to procure and train additional units and qualified persons to achieve the planned mobilization, more units and persons are needed than are in the regular components (USNGB, 1993). Army and Air National Guard units are located in approximately 3,200 communities in the 50 states, the District of Columbia, Puerto Rico, the Virgin Islands, and Guam.

### ***Air Force Reserve Command (AFRC)***



*Mission:* The Air Force Reserve Command (AFRC) supports the Air Force mission to defend the United States through control and exploitation of air and space by supporting Global Engagement. The AFRC plays an integral role in the day-to-day Air Force mission and is not a force held in reserve for possible war or contingency operations (USAF Fact Sheet, 1997b).

### ***United States Air Forces in Europe (USAFE)***



*Mission:* USAFE has transitioned from a fight-in-place fighter force postured for a large-scale conflict to a mobile and deployable mixed force that can simultaneously operate in multiple locations. Since the end of the Cold War, USAFE's role in Europe has also expanded from tasks associated with warfighting to a mission that includes supporting humanitarian and peacekeeping operations, and other non-traditional tasks. In peacetime, USAFE trains and equips U.S. Air Force units pledged to NATO. USAFE plans, conducts, controls, coordinates and supports air and space operations to achieve U.S. national and NATO objectives based on taskings by the

commander in chief, United States European Command. Under wartime conditions USAFE assets, augmented by people, aircraft and equipment from other major commands and the Air National Guard and Air Force Reserve, come under the operational command of NATO. The command's inventory of aircraft is ready to perform close air support, air interdiction, air defense, in-flight refueling, long range transport and support of maritime operations. In fulfilling its NATO responsibilities, the command maintains combat-ready wings dispersed from Great Britain to Turkey. USAFE supports U.S. military plans and operations in Europe, the Mediterranean, the Middle East and parts of Africa. USAFE remains a formidable force in Europe despite a rapid drawdown that saw its main operating bases cut by 67 percent following the end of the Cold War. As witnessed in the command's support of contingency and humanitarian operations throughout Europe and parts of Africa, USAFE remains a highly responsive combat command with a strong, capable force (USAF Fact Sheet, 1997e).

### ***Pacific Air Forces (PACAF)***



*Mission:* PACAF's primary mission is to plan, conduct and coordinate offensive and defensive air operations in the Pacific and Asian theaters. The command provides advice on the use of aerospace power throughout the theater and carries out missions as directed by the commander in chief of the U.S. Pacific Command. As a major command, PACAF is responsible for most Air Force units, bases and facilities in the Pacific and Alaska. The command ensures that Air Force units in the region are properly trained, equipped and organized to conduct tactical air operations. PACAF's goals are to:

- Forge a fighting team second to none
- Make operations safe
- Continuously improve performance
- Maintain the highest standards of conduct and appearance
- Improve quality of life for all its people and
- Build quality partnerships with allies, other services, and local communities (USAF Fact Sheet, 1998)

## ***Air Force Materiel Command (AFMC)***



*Mission:* To develop, deliver and sustain the best products for the world's best Air Force. It is the Air Force's largest command in terms of employees and funding. AFMC supports other U.S. military forces and allies and handles major aerospace responsibilities for the Department of Defense. This includes research, development, testing, and evaluation of satellites, boosters, space probes and associated systems needed to support specific National Aeronautics and Space Administration projects. AFMC researches, develops, tests, acquires, delivers and logistically supports

every Air Force weapon system as well as other military non-weapon systems. AFMC works closely with its customers--the operational commands--to ensure each has the most capable aircraft, missiles and support equipment possible. AFMC uses five goals to help build a better Air Force:

- Satisfies its customers' needs in war and peace
- Enables its people to excel
- Sustains technological superiority
- Enhances the excellence of its business practices
- Operates quality installations (USAF Fact Sheet, 1997c)

## **2. Mission-Oriented Tasks and Task Lists**

Recently, throughout the Department of Defense (DoD), a movement to identify the universal mission-oriented tasks has been implemented in all United States (US) Military Services. The Chairman of the Joint Chiefs of Staff Manual (CJCSM) 3500.04A, Universal Joint Task List (1996) governs this effort. Each service has developed its own universal and mission essential task lists, and they have begun developing MOEs and MOPs to measure performance on these tasks. The purpose of the CJCSM is to be a common reference source for joint force commanders to assist them to communicate their mission requirements. It should be noted that mission task lists are in their infancy, and both growth and improvement in the task lists and associated metrics are expected over the next several years. In fact, the 1996 CJCSM is already being updated (CJCSM 3500.04A, Draft 1998), and the Services are in the process of defining tactical tasks and metrics.

### ***Types of Mission Tasks***

A mission task is a "discrete event or action, not specific to a single unit, weapon system, or individual, that enables a mission or function to be accomplished – by individuals or organizations (CJCSM 3500.04A, Draft 1998, p 1-5). Mission tasks must be discrete, or different and separate from other mission tasks. However, the relationships between a particular task and multiple other tasks may be complex (i.e., one task supports or enables other tasks). This concept is the basis for the development of tasks found in the CJCSM 3500.04A, Universal Joint Task List (Draft, 1998) and AFDD 1-1, Air Force Task List (1998). When tasks are used in association with specific missions of particular organizations, they must become more detailed in definition. This report highlights differences in the types of tasks, and the relationship between the Air Force Task List (AFTL) (AFDD 1-1, 1998), and the Universal Joint Task List (UJTL) (CJCSM 3500.04A, Draft 1998). First presented are the types of mission-related tasks.

### ***Mission Essential Task (MET)***

A Mission Essential Task (MET) is "a task expanded on from the AFTL (or from the UJTL or other Service universal task list) as a fundamental requisite for the performance or accomplishment of an organization's assigned mission. An organization should have a limited number of METs" (AFDD 1-1, 1998, p 1). While all tasks performed in each Service are important, most are performed to support or

enable the essential tasks that are the reasons each particular organization exists. At echelons below the MAJCOM, there is a collaborated METL development process; however, the approval authority resides with the MAJCOM commander. The MAJCOM commander approves the standards set for the performance of the tasks when he or she approves the METL. A MET is described in terms of the task, the conditions under which it is performed, and a metric to determine how effectively the task was accomplished, which are addressed below in more detail.

**Task.** Tasks addressed in this report are primarily mission-related tasks, rather than individual tasks assigned to a person by skill specialty code (or Air Force Specialty Code [AFSC]). The mission task is the essential action that must be taken.

**Conditions.** Conditions are variables of the environment, or situation in which a unit, system, or individual is expected to operate within, that affect performance. Conditions are classified by (1) physical environment (e.g., climate, outer space, or specific terrain), (2) military environment (e.g., threat, command relationships), and (3) civil environment (e.g., political, cultural, and economic factors).

**Standards or MOEs.** MOEs provide a measure of how well an organization or force must perform a task under a specific set of conditions for a specific mission. The measures express the minimum acceptable proficiency required for a particular task. These MOEs are called standards. These standards, when linked to conditions, provide a basis for planning, conducting, and evaluating a mission or training event. During the collaborative METL development process, an organization selects measures from the list, modifies them as needed, or can create different measures as needed. Additions or corrections to the measures are expected, and AFDD 1-1 will be updated to maintain a common language throughout similar Air Force organizations. All wartime/contingency requirements should be considered when setting standards.

### **Air Force Core Tasks**

The AFTL is structured on the institutionally accepted Air Force core competencies: (1) Air and Space Superiority, (2) Precision engagement, (3) Information Superiority, (4) Global Attack, (5) Rapid Global Mobility, (6) Agile Combat Support, and (7) Command Control of these competencies.

According to AFDD 1-1 (1998, p 35), the “Secretary of the Air Force canonized the core competencies into Air Force doctrine with *Global Engagement*. AFDD 1, *Air Force Basic Doctrine*, (1998) followed this decree with a more detailed explanation of each core competency.” Therefore, AFDD 1-1 followed suit and, unlike the other services, used these core competencies as the headings of the AFTL outline. It is the contention of the AF developers that the structure of the UJTL and other service Universal Task Lists (UTLs) is more suited for describing a land battle, rather than describing air power issues (Personal communication with several developers of the AFTL, Jul 98). The Air Force contributes to the defense of the nation by providing each of these core competencies and their command and control. The core competencies are expressed as Air Force tasks when the letters “AFT” and a number and the verb “Provide” are placed in front of each competency: e.g., AFT 5, *Provide Rapid Global Mobility*, or AFT 6, *Provide Agile Combat Support*. Though not an Air Force core competency, *Provide Command and Control* is expressed as a core task (AFT 7), since it is needed to control the other core tasks.

**Supporting Task.** A supporting task is a “specific activity that contributes to the accomplishment of a mission essential task. Supporting tasks are accomplished at the same command level or by subordinate elements of a force.” (AFDD 1-1, 1998)

**Enabling Task.** An enabling task is “specific activity that makes it possible to accomplish a mission essential task” (AFDD 1-1, 1998). Successful completion of an enabling task does not guarantee the accomplishment of a MET; however, unsuccessful completion will most assuredly result in failing to accomplish the MET. The failure to accomplish many of the tasks in AFT 6, *Provide Agile Combat Support*, for example, will result in the failure of most of the subordinate tasks in AFT 1, *Provide Air and*

Space Superiority; AFT 2, Provide Precision Engagement; AFT 4, Provide Global Attack; and AFT 5, Provide Rapid Global Mobility. Failure to accomplish AFT 5.1.2, Educate and Train Airlift Operations Forces (to include aeromedical evacuation forces); AFT 6.2.1, Protect the Force; or AFT 6.5.1.3, Perform Air Mobility Support, will eventually prevent the acceptable accomplishment of AFT 5.1.1, Perform Airlift Operations (and aeromedical evacuation, as well). Another example: failure to accomplish AFT 6.1.1.12, Recruit and Access a Quality Force, will result in the eventual failure to accomplish any of the tasks throughout the AFTL. Tasks must be judiciously selected because if all enabling tasks were listed as METs in each organization, the list would become excessively long, unmanageable, and thereby of little or no utility to the organization.

**Command-Linked Task.** Command-linked tasks “depict the interface between supported and supporting commands and agencies” (CJCSM 3500.04A, Draft 1998, p 1-4). These tasks are key to accomplishing supported command or agency Joint Mission Essential Tasks (JMETs). The supported commander normally designates and assesses the command-linked tasks. The command performing the task normally evaluates task accomplishment. Close coordination and communication are required between supported and supporting commands.

### **Types of Task Lists**

Two primary mission task lists exist--the universal and the tactical, or mission essential, task lists. The Chairman of the Joint Chief of Staff has a universal task list--the Universal Joint Task List (UJTL)--and each Service has a universal and a mission essential task list.

#### **Universal Task Lists (UTLs).**

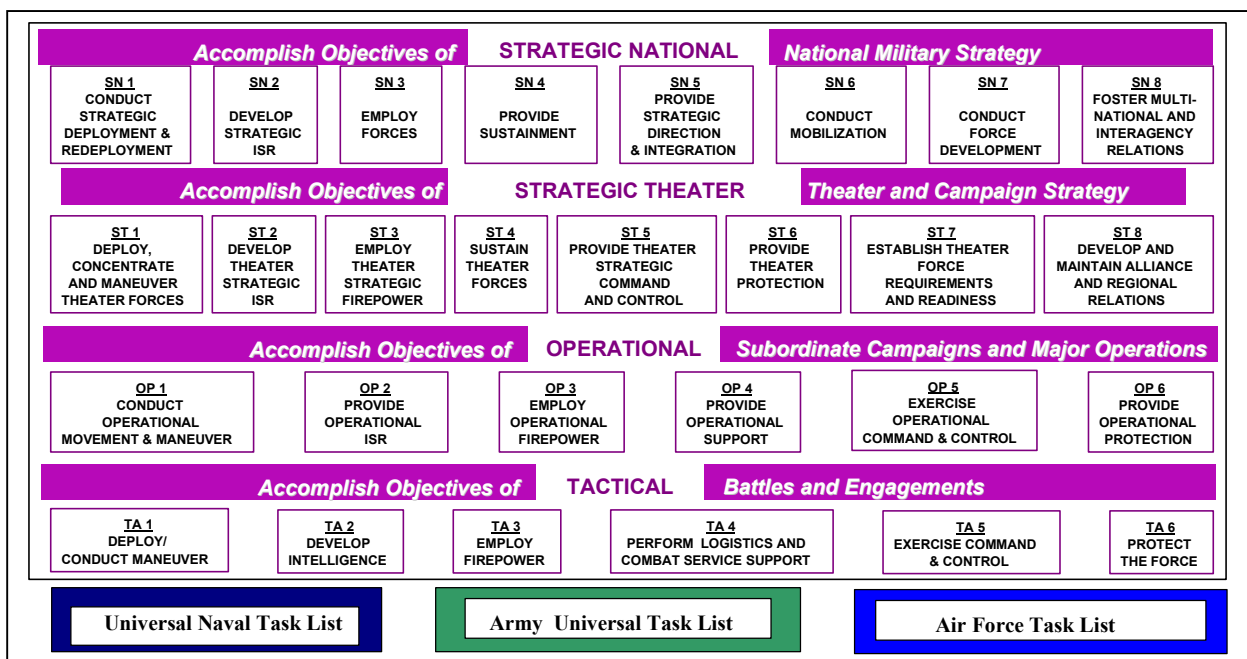
The Joint Chiefs and each Service has a universal task list. All are organized similarly, except the AF, which chose to organize its universal tasks under the six AF core competencies, plus one for command and control of those core competencies.

**Universal Joint Task List (UJTL).** The UJTL is designed as a comprehensive task using a common language for joint force commanders (JFCs). The current version (Fig. 3) is vertically structured around the levels of war. The strategic level is subdivided into strategic national and strategic theater levels, giving the impression of four levels of war. Approved joint doctrine and current doctrines of the AF and the other Services adhere to the concept of only three levels of war: strategic national, operational, and strategic tactical (see Table 3). The UJTL’s horizontal structure is based on the relationship in the Army’s traditional Battlefield Operating Systems (BOS), e.g., categories of movement and maneuver, firepower, support, command and control, etc. (Fig. 3). “While the BOS have served the Army in organizing and performing needed tasks on the battlefield, they proved insufficient to organize or to reflect the potential of aerospace power” (AFDD 1-1, 1998, p 3). AFTL developers expect future versions of the UJTL will reflect the capabilities of the entire joint community. The UJTL concept is growing in influence and importance in determining many types of requirements for the military community.

**Air Force Task List (AFTL).** The AFTL is summarized in Figure 4. It provides a framework to express all Air Force activities contributing to the defense of the nation and its national interests. The AFTL is organized around the Air Force’s core competencies and their command and control. Thus, the AFTL is structured to remain congruent with established Air Force doctrine and compliant with the functions as assigned to the US Air Force by Title 10, United States Code (U.S.C.), and the Department of Defense (DOD). Because of this structure centered on AF core competencies, the AFTL does not directly coincide with the UJTL, as the Army’s AUTL and Naval UNTL do. The AFTL is also written at a higher level of abstraction than other Service task lists so that most tasks could apply to different functions within the Air Force.

**TABLE 3. Levels of War Definitions Addressed in UJTL and Service Task Lists**  
(Adapted from CJCSM, 1996, and DA Pamphlet [Draft], 1998).

Level of War (Prefix)	Task Area Definition
<b>Strategic National (SN)</b>	The major tasks occurring at the national military and theater strategic level performed by civil and military organizations and Joint or multinational forces for successfully executing strategic plans/theater campaigns.
<b>Operational (OP)</b>	The major tasks occurring in the theater of operations or Joint operational area, performed by Joint or multinational forces for successfully executing subordinate campaigns and major operations.
<b>Strategic Tactical (ST)</b>	The major tasks occurring in the battlespace performed by each Service's forces to successfully execute tactical operations (battles and engagements) to accomplish military objectives of the operational commander. Activities at this level focus on the ordered arrangement and maneuver of combat elements in relation to each other and to the enemy to achieve combat objectives. Each Service provides a listing of their tactical tasks (below).
<b>Air Force Tactical (AFT)</b>	The Air Force Task List contains these tasks.
<b>Army Tactical (ART)</b>	The Army Universal Task List contains these tasks.
<b>Naval Tactical (NTA)</b>	The Universal Naval Task List contains these tasks.



**FIGURE 3. Universal Joint Task List (UJTL) Organization, Version 3.0.**  
(Adapted from CJSCM, 1996)

11 May 1998		Air Force Task List				AFDD 1-1	
PROVIDE AIR AND SPACE SUPERIORITY AFT 1		PROVIDE PRECISION ENGAGEMENT AFT 2			PROVIDE INFORMATION SUPERIORITY AFT 3		
Provide Counterair Capabilities  AFT 1.1	Provide Counterspace Capabilities  AFT 1.2	Provide Lethal Precision Engagement Capabilities  AFT 2.1	Provide Nonlethal Precision Engagement Capabilities  AFT 2.2	Provide CSAR Capabilities  AFT 2.3	Provide Information Operations Capabilities  AFT 3.1		
PROVIDE GLOBAL ATTACK AFT 4				PROVIDE RAPID GLOBAL MOBILITY AFT 5			
Provide Strategic Attack Capabilities  AFT 4.1	Provide Counterland Capabilities  AFT 4.2	Provide Countersea Capabilities  AFT 4.3	Provide Special Operations Forces Employment Capabilities  AFT 4.4	Provide Airlift Capabilities  AFT 5.1	Provide Air Refueling Capabilities  AFT 5.2	Provide Spacelift Capabilities  AFT 5.3	Provide ASETF Capabilities  AFT 5.4
PROVIDE AGILE COMBAT SUPPORT AFT 6							
Provide the Capability to Ready the Force  AFT 6.1	Provide the Capability to Protect the Force  AFT 6.2	Provide the Capability to Prepare the Operational Environment  AFT 6.3	Provide the Capability to Position the Force  AFT 6.4	Provide the Capability to Employ the Force  AFT 6.5	Provide the Capability to Sustain the Force  AFT 6.6	Provide the Capability to Recover the Force  AFT 6.7	
PROVIDE COMMAND AND CONTROL AFT 7							
Monitor Global Conditions and Events  AFT 7.1		Assess Global Conditions and Events  AFT 7.2		Plan Military Operations  AFT 7.3		Execute Military Operations  AFT 7.4	

FIGURE 4. Air Force Task List (AFTL) (AFDD 1-1, 1998).

**AFT x Provide “Core Competency”**  
**AFT x.x Provide “Capability”**  
 AFT x.x.1 Perform “ task”  
 AFT x.x.2 Educate and Train “ task” forces  
 AFT x.x.3 Equip “ task” forces  
 AFT x.x.4 Plan to “ task”

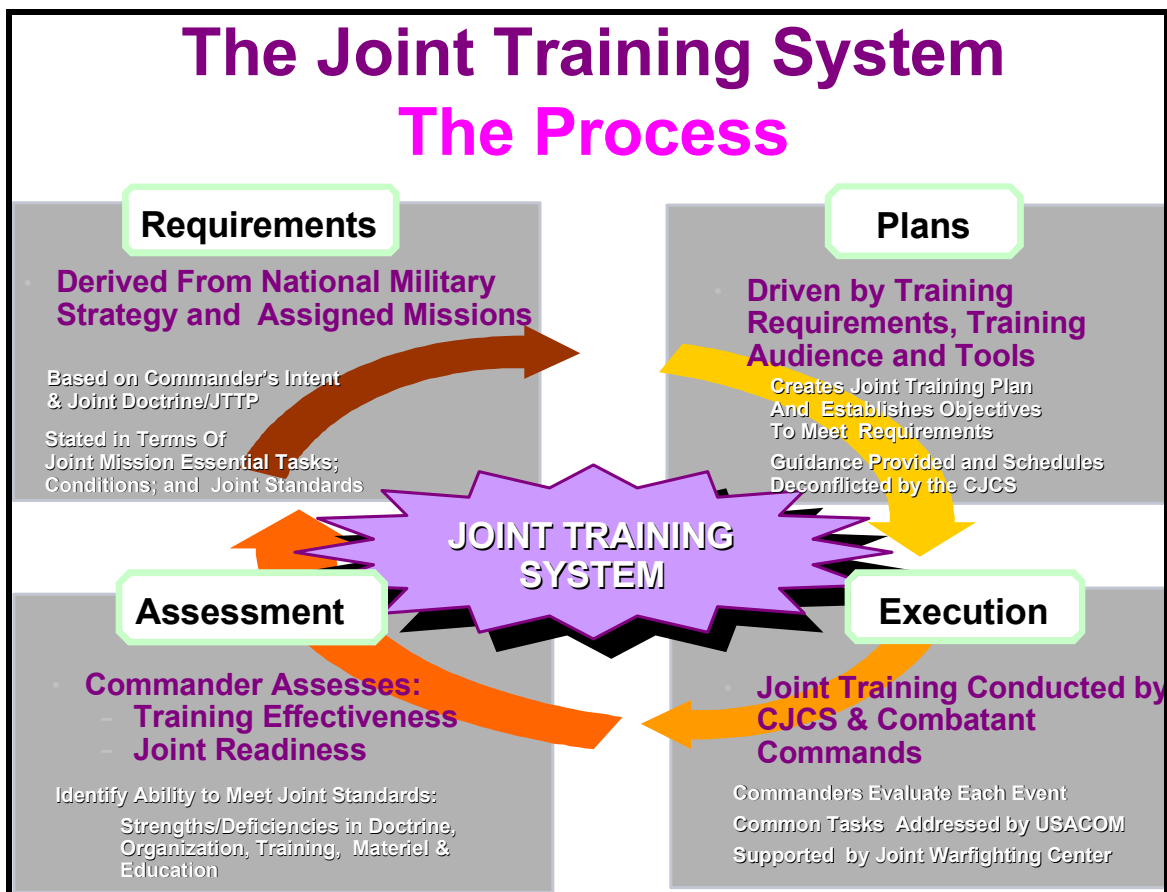
FIGURE 5. AFTL Generic Task Organization.

The AF core competency is listed at the top level, the specific capability next, and then the specific task to be performed, to educate and train the task, equip related task forces, and finally, to plan the task (see Fig. 5). According to AFTL developers, its structure complements the UJTL by providing Air Force specific tasks. In addition, it offers a “modern structure” (AFDD 1-1, 1998) for eventual inclusion into CJCS manual. While this modern structure does not *numerically* align Air Force tasks with the traditional battlefield operating structure present in version 3.0 of the UJTL, the tasks are functionally related.

### Mission Essential Task Lists (METL)

A METL is a complete list of tasks considered essential to accomplishment of assigned or anticipated missions for a particular organization. A METL includes associated conditions and standards and may identify command-linked and supporting tasks. A METL differs from a universal task list in that it is specific to a particular organization. METLs are to be developed by MAJCOMs, Numbered Air Forces, and wings.

**Joint Mission Essential Task List (JMETL).** Modern warfare is joint warfare. Consequently, the US military must train jointly to fight successfully. With the lack of resources evident today, to be in the highest state of readiness, units must selectively choose the tasks they can train. The JMETL can assist commanders in selecting the most appropriate tasks for training to the highest state of readiness. Combatant commanders (Commanders In Chief [CINCs]) are assigned missions based on their geographic areas of responsibility or on their functional capabilities. Missions are assigned in the Joint Strategic Capabilities Plan (JSCP), National Command Authority taskings, treaty obligations, or other tasking documents in accordance with the principles and procedures found in the Unified Command Plan (UCP) and the Unified Action Armed Forces (UNAAF). Through careful analysis of assigned missions, combatant commanders develop a concept of the operation and identify a set of mission-based required capabilities. Required capabilities are expressed in terms of the essential tasks to be performed, the conditions under which these tasks are performed, and the standards to which these tasks must be performed. The CJCSM supports the JMETL development process in the requirements phase of the four-phased Joint Training System. (See Figure 6 for an illustration of the relationship of the JMETL and the joint training process.)



**FIGURE 6. The relationship between the JMETL and the Joint Training System. (CJCSM, 1998).**

**Air Force Mission Essential Task Lists (AFMETLs).** AFMETLs are a critical part of Air Force planning. The Air Force Strategic Plan, Volume 2, states that MAJCOM and wing/unit strategic plans should contain mission essential tasks relevant to their mission and the CINC(s) they support. According to the AFTL (1998), “organizational performance planning is aimed at enhancing the performance of near-term mission essential tasks. Organizational performance planning ‘operationalizes’

quality by establishing Air Force goals, aligning tasks to mission, and establishing performance priorities.”

A brief discussion regarding the state of development of METLs and MOEs may be helpful. Presently, METLs below the Air Force level, with one exception, have yet to be developed. Our expectation is that METLs will be related to the AFTL tasks. Air Education and Training Command (AETC) has developed draft METLs that are published in the AFTL as samples.

### ***Uses of UTLs and METLs***

The Joint and Service task lists (both UTLs and METLs) may be used to support education and training, test and evaluation, operational planning, and readiness assessment. Each is briefly addressed below.

***Training.*** Training developers may use the UTL and METL hierarchy to determine tasks to be accomplished to support unit missions. The UTLs and METLs provide training developers with a comprehensive list of mission-oriented tasks that serves as a checklist. The checklist can help ensure that critical mission tasks are included in the analyses that support the design and development of training material. Thus, UJTL, JMETL, and AFTL may be useful in developing unit METL at various echelons in both the active and reserve components.

***Education.*** The UTLs and METLs may also be useful to help set priorities in staff and senior service colleges, and to translate Service tasks to a common language. For example, the Army Universal Task List has been used at the US Army’s Command and General Staff College and the US Marine Corps’ Command and Staff College in courses on the operational level of war and in the study of campaign planning. It has been used at the US Army War College to help educators ensure that the curriculum includes all appropriate strategic and operational subject areas. (DA Pamphlet 11-XX, 1998)

***Test and Evaluation.*** Complex tests and evaluations can be subdivided into smaller subtests for planning and execution purposes by following a top-down path through task lists to a group of logically related tasks. Test reports can use the indexing feature of the UJTL and Service task lists to provide clear statements of what battle tasks were addressed in the test and to aid the tracking of test results for task-related tests. Further, task MOEs and MOPs can be used to evaluate the tests.

***Operations Planning.*** The UTLs and METLs are useful for planning operations, to include both deliberate and crisis action. They provide a structured way of considering tasks that the Services might perform in any operation either alone or as part of a Joint or multinational force. The commander can use these task lists as a checklist when developing plans and orders. The task lists can help ensure that all Service functions are included in operations planning.

***Readiness Assessment.*** Unit commanders can use their METL as a framework for assessing the training performance and readiness of their forces. A training readiness assessment determines whether forces can execute their assigned missions. The METL/JMETL processes identify those tasks necessary for the successful execution of assigned missions. An example of the application of METLs is that of readiness assessment in the Joint Monthly Readiness Review (JMRR). The JMRR is based in part on specific scenarios. The JMRR requires commanders to assess the performance on specific tasks critical to mission success under specific condition. The METL provides a vehicle for assessing performance under specific conditions and to a standard. The AF recognizes three types of readiness assessment to determine that forces are ready to perform on specific types of tasks (AFDD 1-1, 1998):

***Operational Assurance.*** Operational assessments that can assure commanders of the readiness of their outfits are critical. Such assessments (e.g., ORI, tactical evaluation) are invaluable as an independent, third-party verifications of unit capability. These assessments give commanders a critical and unique level of confidence that subordinate units are mission capable. In this sense, the operational assessment will continue as an integral part of the Air Force’s overall assurance system.

**Compliance Assurance.** Compliance assurance (e.g., STAN EVAL, nuclear surety, and safety) is necessary to ensure that the AF, as an institution, complies with established standards – a prime example being Nuclear Surety Inspections. The Air Force Strategic Plan, Volume 2, addresses the directives governing compliance assurance.

**Task Assurance.** The third component of assurance indicates unit progress on meeting standards reflected in established METLs. The Air Force Strategic Plan, Volume 2, provides greater detail concerning the conduct, reporting and utility of the task assurance process.

### 3. MAJCOM-Level Performance Measurement

At the MAJCOM level, performance measures assess how well the command is accomplishing mission essential tasks in support of Air Force goals. Subordinate organizations (Numbered Air Forces, wings) develop their own strategic plans, which support the MAJCOM- and Air Force-level strategic plan by identifying their own measurable tasks on which to focus attention (see Figure 7). Those goals will also focus attention on quality issues related to the organization's mission essential tasks. The mission performance process, explained in Volume 2 of the Air Force Strategic Plan, includes three components, each essential to operationalizing quality: *Strategic Plans*, *Task Lists*, and *Measures*. At the MAJCOM and unit level, progress in moving toward the Air Force goals will ultimately be assessed by how well each unit accomplishes its mission essential tasks.

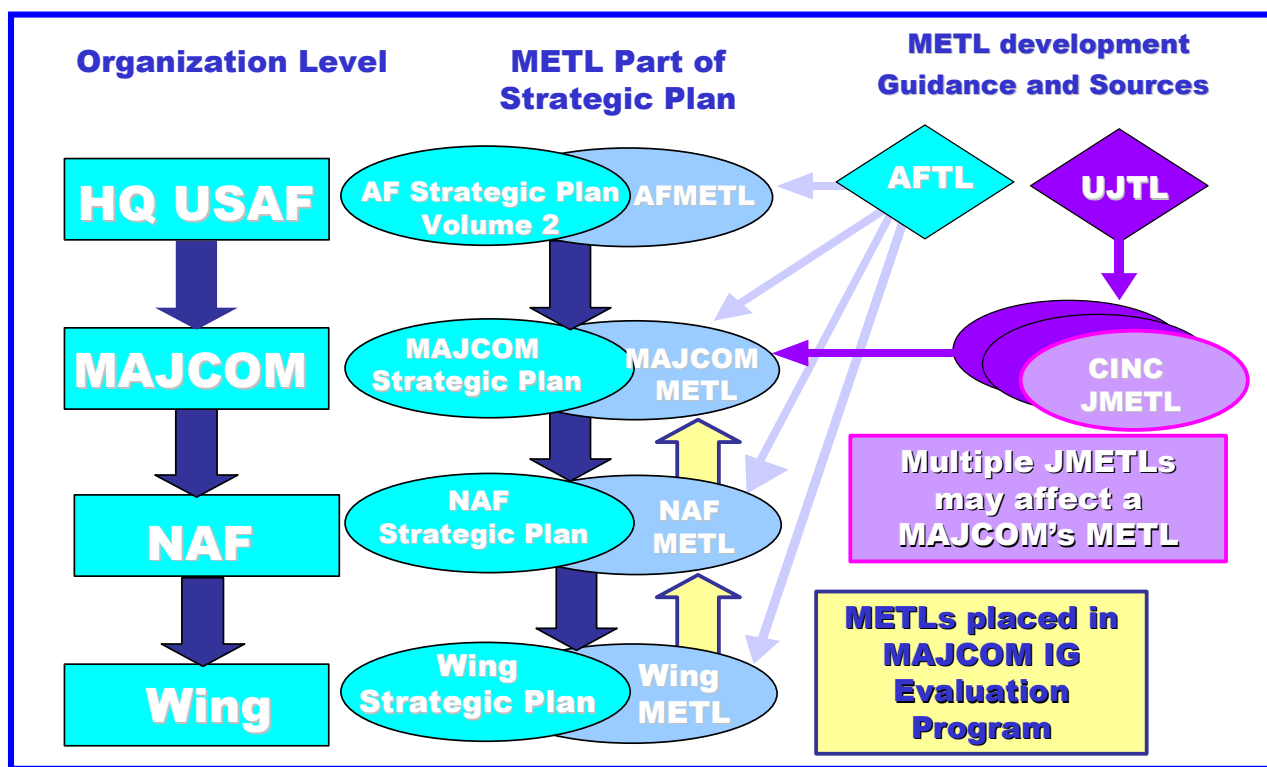


FIGURE 7. AFTL and AFMETL during Planning Process (AFDD 1-1, 1998).

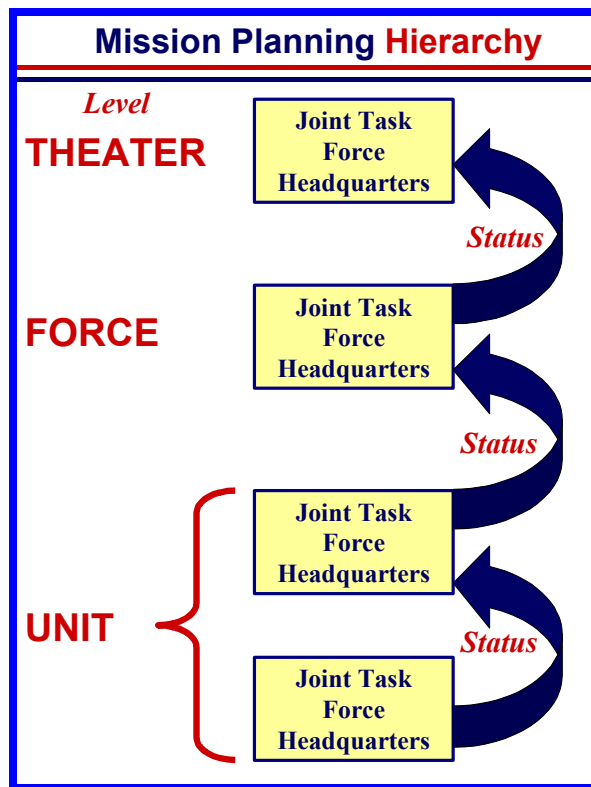
#### MAJCOM MOEs/MOPs

##### Mission Planning

To understand the usefulness of MOEs/MOPs in evaluating war-fighting capabilities, it is important to know the structure for planning a mission. Figure 8 and the accompanying sections provide

important background information on the tactical mission-planning process of the USAF from theater level through unit level. At the top of the command hierarchy is the Joint Task Force (JTF) Commander. The JTF Commander has authority over all land, sea, and air resources within the theater of operations. The JTF Commander is responsible for determining the military objectives that must be accomplished to meet the objectives of the campaign. These military objectives often change on a day-to-day basis, driven by the results of previous interactions between friendly and hostile forces. The JTF Commander works with his staff to determine strategies that will accomplish the current goals (Bradford, Brett, & Phelps, 1995).

The Air Operations Center (AOC) provides the capabilities to perform hostile force analysis and friendly force planning. The AOC determines the appropriate target list based on military objectives and available resources, as well as determining allotment of aircraft and munitions to be used on each target. The AOC also attempts to control missions at a theater level to minimize collisions/interference between the various aircraft. The Contingency Tactical Air Control System Automated Planning System (CTAPS) is currently used to automate this process. The primary result of AOC's planning is the Air Tasking Order (ATO). According to Bradford, Brett, & Phelps (1995), for each mission, the ATO contains information (e.g., MOEs/MOPs) such as: Target(s) to be attacked, Number and type of aircraft for each target, Airbase of mission origin, Munitions to be used on each target, Critical way-points information (e.g., takeoff time, time on target, refueling points, etc.), and Support forces (e.g., refueling and jamming).



**FIGURE 8. Mission Planning Hierarchy.**  
(Bradford, et al., 1995)

Each mission has a set of MOEs/MOPs. Commanders judge how well their personnel perform based on feedback for a number of missions.

At the Wing Operations Center, information relevant to the particular wing is broken out of the ATO into a Fragmentation Order. Based on this Fragmentation Order, the wing determines if there are enough resources (aircraft, aircrew, and munitions) to accomplish the specified missions. If the wing

lacks the resources to perform any of the missions, this status is passed back to the AOC. Remaining missions are then passed to squadrons within the wing. There are many existing planning/command and control systems in use by various wings. However, a standard system, e.g., the Wing Command and Control System (WCCS), will become the common planning platform in the future (Bradford et al., 1995).

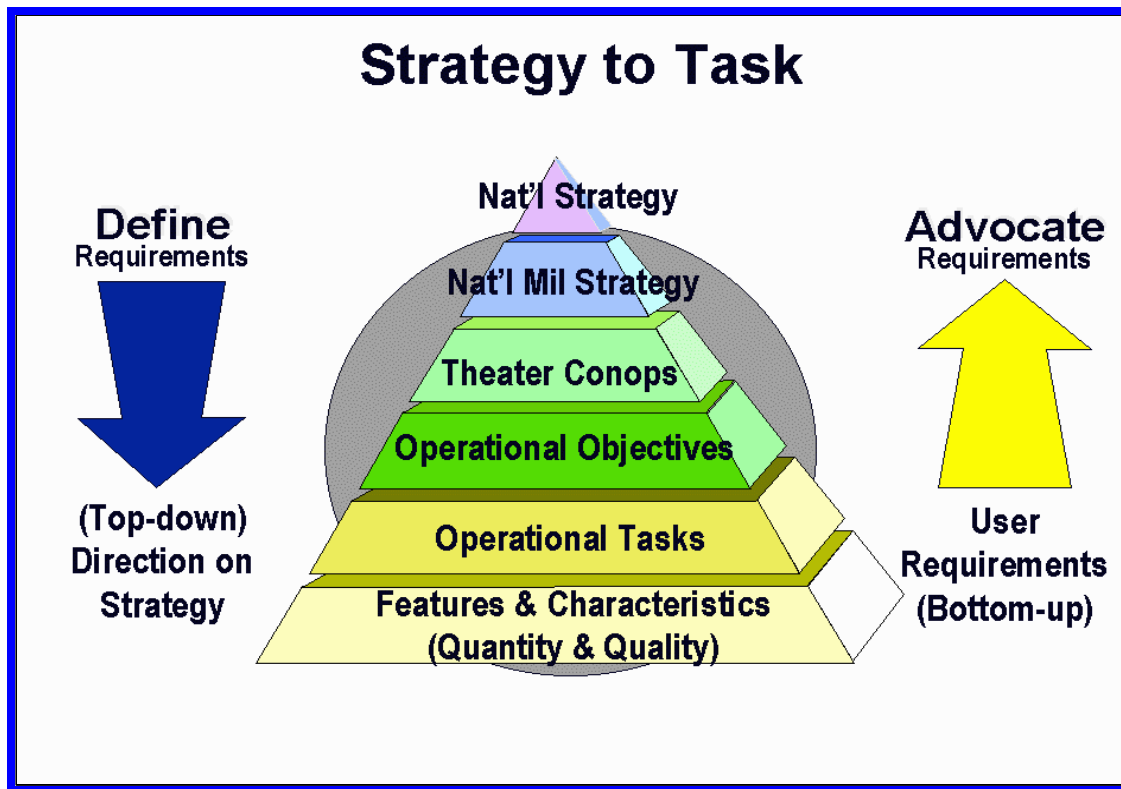
The Squadron Operations Center is responsible for planning individual aircraft routes based on the Fragmented ATO. The planning process attempts to maximize the probabilities of meeting the ATO objectives while minimizing the risk imposed by hostile threats. To assist in the planning process, the aircrews utilize Air Force Mission Support System (AFMSS), the standard unit level mission planning system deployed within the AF for aerial missions ranging from day-to-day training and proficiency flying, to peacetime operational/exercise sorties, and to complex operations supporting conventional or unconventional armed conflict (Bradford et al., 1995).

### ***Air Force Modernization Planning Process***

One of the goals of the AF Modernization Planning Process (MPP) is to produce Mission Area Plans and Mission Support Plans that evaluate AF MAJCOM mission areas tasks to pinpoint deficiencies. These plans show how the AF can arrange to affordably overcome those deficiencies to achieve improved combat capabilities for the future. If a deficiency can be measured, then it is conceivable that the reverse could be considered an MOE. In determining how much adjustment in performance is needed to correct a deficiency, the commanders and high-level decision-makers are, in essence, developing MOEs/MOPs. ACC/DR-MAST is embarking on an effort to develop high quality MOEs/MOPs for each technology need to more clearly communicate the needs to the AMFC Product Center (Personal Communication, 1996). For this reason, it is important to investigate the MPP to meet the objectives of this study. The following sections discuss Mission Area Assessments, Mission Needs Analyses, Mission Solution Analyses, Mission Area Plans, and Functional Area Plans and how they relate to the MPP.

#### ***Mission Area Assessment***

The Mission Area Assessments (MAAs) accomplished by the MAJCOMs are good sources of MOEs and MOPs (AFOTECH 99-101, 1995). Strategies-to-tasks are refined in the MAAs (Figs. 9 and 10). MAJCOMs review Defense, Joint and AF guidance, the missions assigned them under the concepts of operations (CONOPS) of various regional plans and the theater commander's list of prioritized tasks to accomplish those missions (AFI 10-1401, 1995; AFPD 10-14, 1995). Mission Area Teams (MATs) are formed to perform MAAs to link requirements to strategies-to-tasks. HQ USAF/XOXP then provides a Strategies-to-Tasks baseline upon which MAJCOMs can build for MAA (AFPD 10-14, 1995; USAF/XOXP, 1996). Other good sources are the Mission Need Statements (MNSs) that result from the MAAs.



**FIGURE 9. Strategy-to-Task.**  
 (From Modernization Planning Process, McKenzie, 1996)

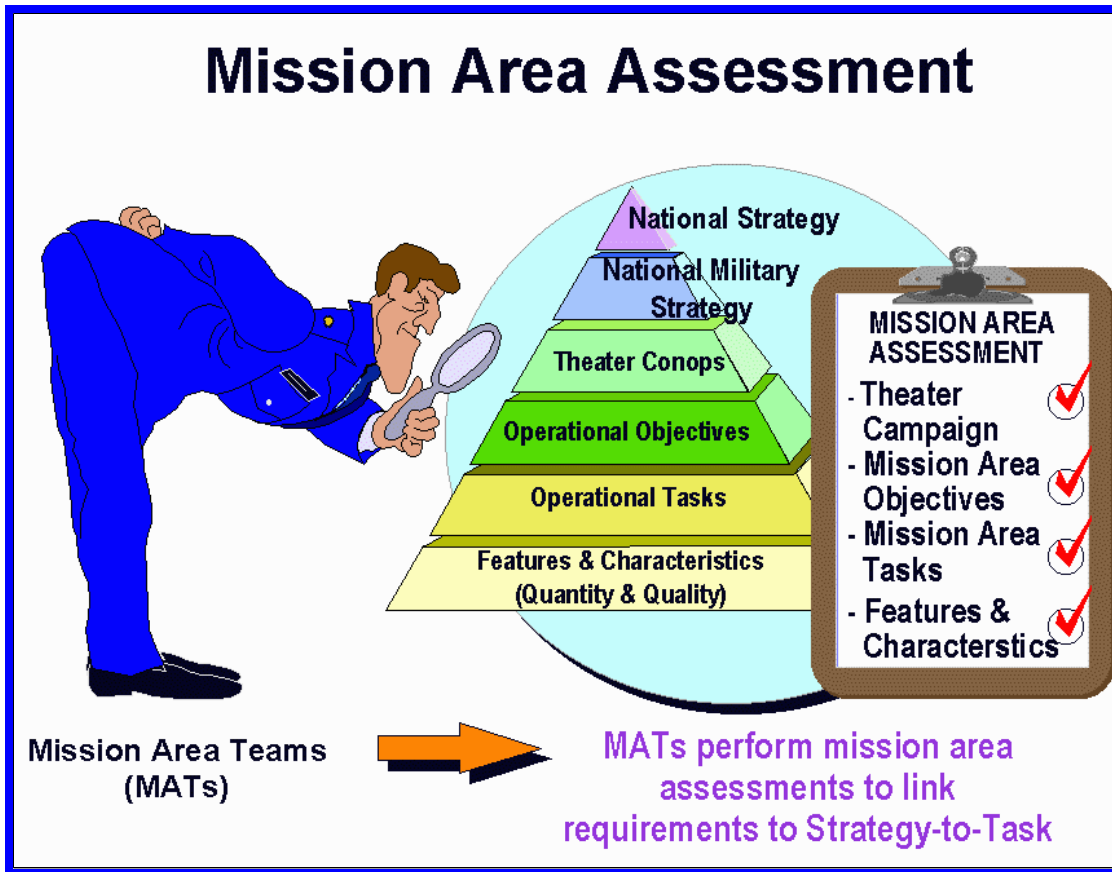
### ***Mission Needs Analysis***

A Mission Needs Analysis (MNA) refines task to need (Fig. 11). Further, the MNA assesses the AF's ability to accomplish the tasks identified during the MAA (AFI 10-1401, 1995).

MAJCOMs analyze the force structure, geo-political environments, projected advances in technology, interoperability concerns, and expected threats affecting their current and programmed capabilities to accomplish a task (AFI 10-1401, 1995; AFD 10-14, 1995). From this analysis, they identify deficiencies in current and future capabilities, and develop a Mission Needs Statement (MNS) to document specific materiel deficiencies (AFI 99-102, 1994; AFD 10-14, 1995; USAF/XOXP, 1996).

As the acquisition process begins, they refine the MNS into an Organizational Requirements Document (ORD). The ORDs contain essential quantitative and qualitative operational requirements for the proposed system; they are the key to understanding user priorities (AFI 99-102, 1994).

The ORDs also provide a Requirements Correlation Matrix (RCM), which contains specific MOEs and MOPs. Finally, the Test and Evaluation Master Plan (TEMP) documents how these system requirements will be addressed with the test resources available (AFI 99-102, 1994).



**FIGURE 10. Mission Area Assessment (McKenzie, 1996)**

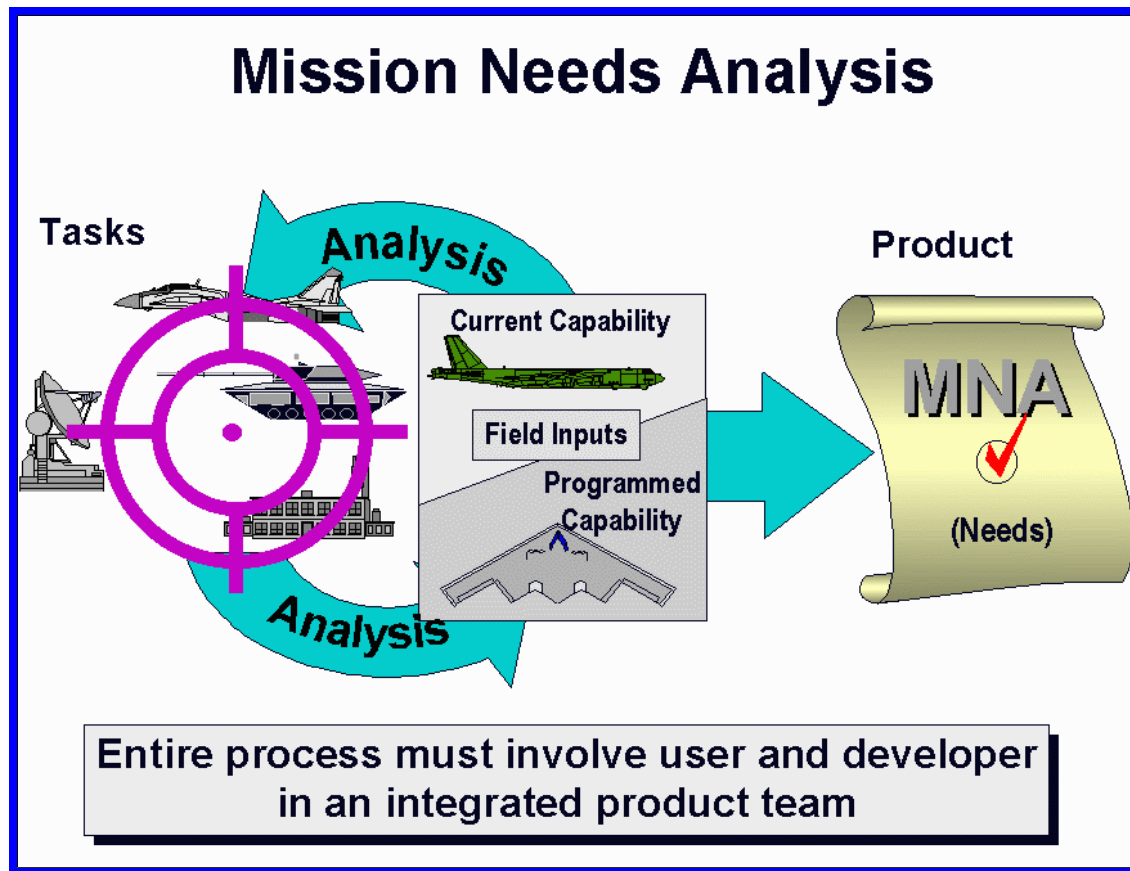
MNA uses a task-to-need methodology to identify mission needs. MNA can also highlight technological opportunities and identify reliability and maintainability improvements that can also enhance warfighting capabilities.

Deficiencies are derived from an iterative process incorporating decision-making methods to include supporting modeling, simulation, or other analytical tools as appropriate. Some criteria to consider are future operational concepts and developing threat technologies.

Needs identified must include mission support and functional areas such as logistics; deployability; reliability and maintainability; Command, Control, Communications, Computers, and Intelligence (C<sup>4</sup>I); human systems requirements (i.e., training, manpower, safety, human factors, etc.); as well as weapons and weapon systems (USAF/XOXP, 1996).

### ***Mission Solution Analysis***

The set of improvement options listed in the MNA must include out-of-the-box and non-material solutions. Such options should include (where appropriate) changes to OPS Tempo, readiness, training, force structure changes, new acquisition, science and technology, out of the box thinking and lean logistics impacts (Fig. 12). This ensures that nonmateriel solutions are considered when trying to correct the deficiencies noted in the MNA (USAF/XOXP, 1996).



**FIGURE 11. Mission Needs Analysis (MNA)**  
(McKenzie, 1996)

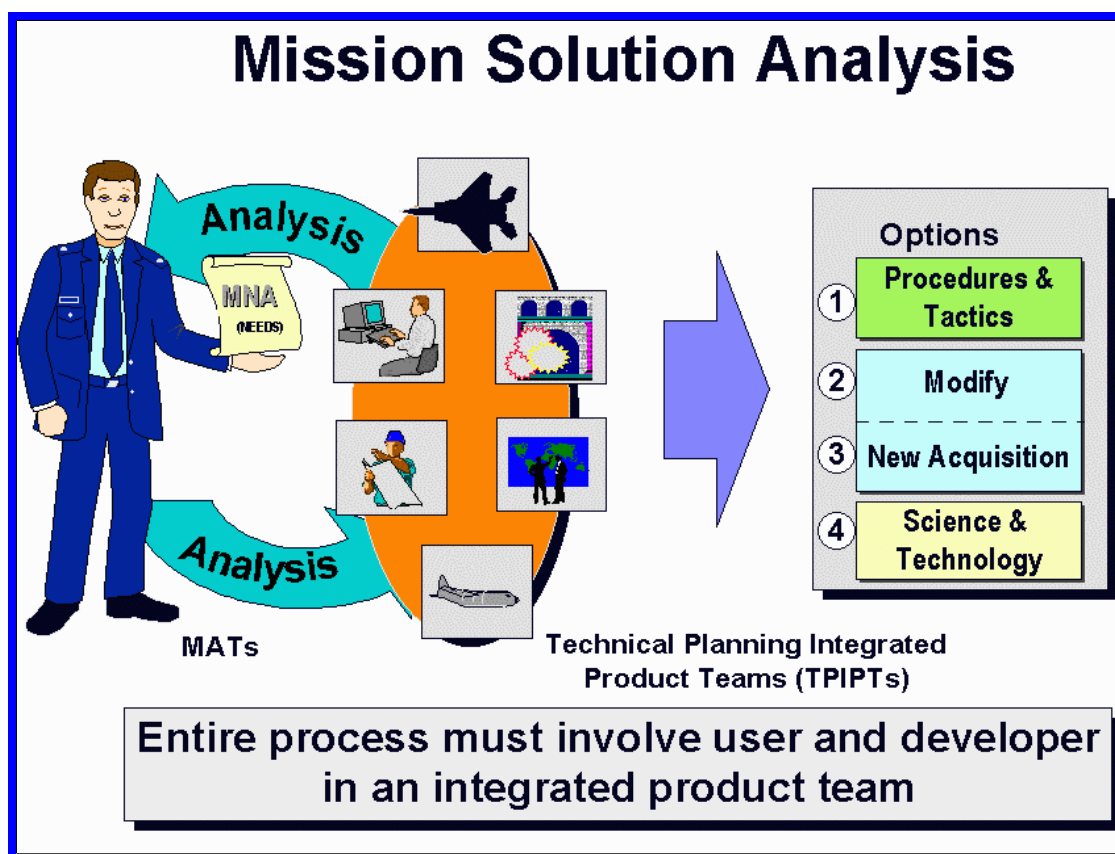
### ***Mission Area Plan***

A Mission Area Plan (MAP) summarizes and uses the products of the MAA and MNA processes to identify key technologies and weapon system modernization efforts required to correct the deficiencies (Figure 13). Based on National Strategy-To-Task analyses, these MAPs evaluate all aspects of AF mission areas, pinpoint deficiencies, and show how the AF plans to affordably overcome those deficiencies to achieve the combat capability it needs in the future. The documents are a combination of descriptive paragraphs and diagrams summarizing the mission area, the implementation CONOPS, the deficiencies identified, and prioritized deficiency corrections (solutions) (ACC/DR, 1996; AFI 10-1401, 1995; AFD 10-14, 1995).

A MAP comprises individual weapon's system/capability roadmaps outlining a modernization plan and descriptions of critical enabling technologies that are the contribution of science and technology programs to correct task deficiencies. Additionally, each MAP must include functional area deficiencies and investments that directly contribute to the success of its operations and are unique to that particular mission area (AFPD 10-14, 1995).

The measure of success for MAPs is how well they improve the performance of AF systems in the modernization process while still remaining fiscally responsible (AFPD 10-14, 1995). The correction of deficiencies within fiscal constraints and technological means changes over time and should show an upward indication as improvements continue and the original deficiency no longer exists (AFPD 10-14, 1995). Each year, MAP Offices of Primary Responsibility (OPRs) report to HQ USAF/XOME the number of mission area deficiencies corrected versus the total number of deficiencies contained in the

MAP (AFPD 10-14, 1995). As shown previously in Table 7, each MAJCOM has its own set of missions. These missions are listed and defined in the MAPs for each MAJCOM. As an example, Attachment 1 of this study provides Recap Sheets (summaries) for ACC's MAPs (ACC/DR, 1996).

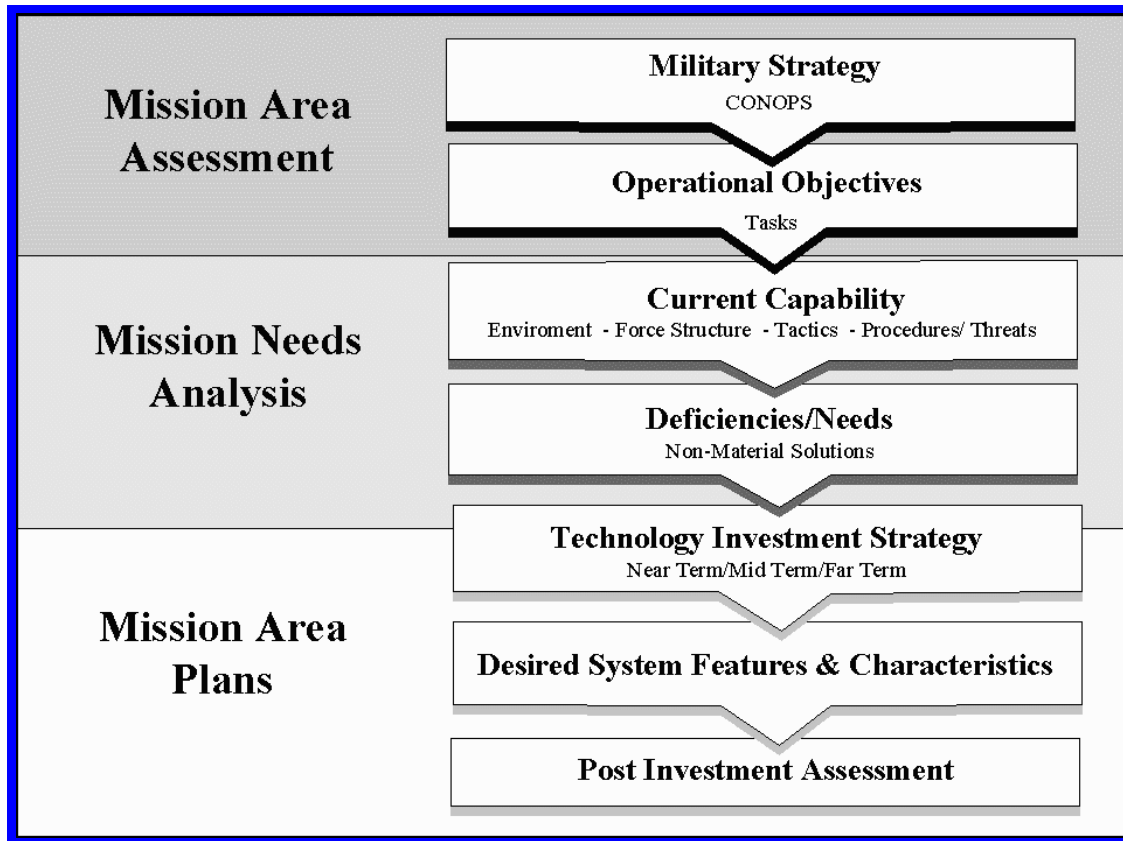


**FIGURE 12. Mission Solution Analysis**  
(McKenzie, 1996)

### ***Functional Area Plan***

An AF functional area (such as Command, Control, Communications, and Computers [C<sup>4</sup>], security police, intelligence, or civil engineering) may develop its own plan, called a Functional Area Plan (FAP), similar to a MAP. This occurs when a functional area must invest in systems or leverage technologies managed across multiple MAJCOMs, Services or Joint, Defense, and National Agencies (AFPD 10-14, 1995). FAPs will not duplicate that which should be in a MAP, i.e. the functional area would not place a requirement for hardware in their FAP that was already listed as a requirement in the MAJCOM MAP. Included in the FAPs are functional deficiencies and investments directly tied to successful implementation of each FAP (AFPD 10-14, 1995).

MAJCOMs integrate MAPs and FAPs to provide the fiscal prioritization across each MAJCOM. These integrations must be sufficiently detailed to support AF modernization planning through the Biennial Planning, Programming, and Budgeting System (PPBS). MAJCOMs coordinate with supported CINCs to prioritize Research, Development, and Acquisition (RD&A) programs to support the MAPs (AFPD 10-14, 1995).

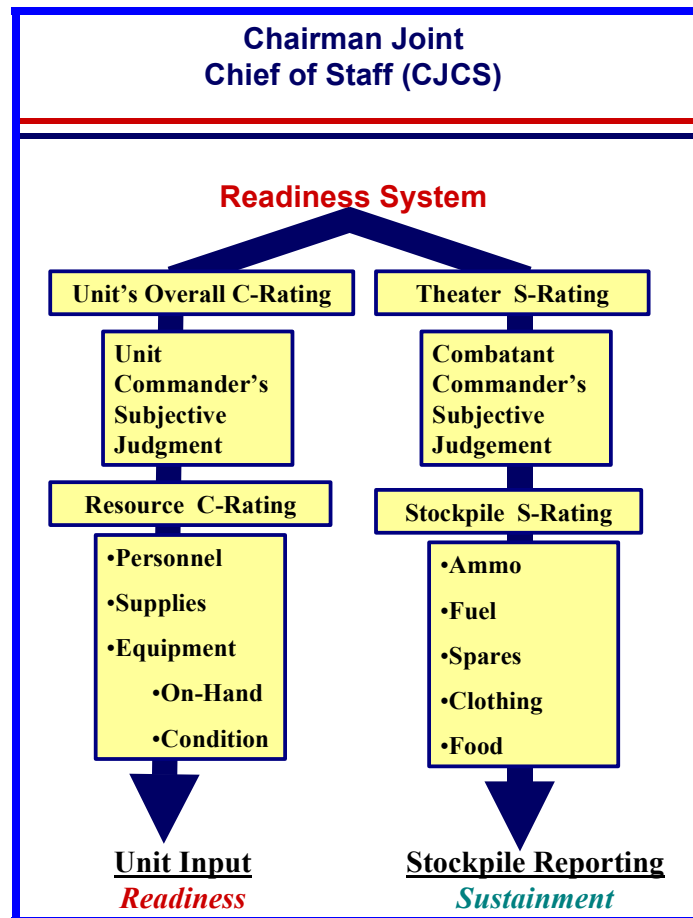


**FIGURE 13. Mission Area Plan Process**  
(From ACC/DRS, 1995b)

#### **4. Readiness Research and Reporting Systems for Decision Makers**

Readiness has been defined (AFPD 10-2, 1997) as the ability of forces, units, weapon systems, or other equipment to deliver the outputs for which they were designed, including the ability to deploy and employ without unacceptable delay. Simply stated, readiness is the evaluation of an organization's ability to accomplish peace and wartime tasks. Readiness is fundamental to the successful accomplishment of the AF mission. Readiness evaluations answer these types of questions: Are there enough resources to do the job? Are the right resources available for the assigned tasks? Are the infrastructure and equipment in good condition? Are the people fit, trained, and qualified? Over time, readiness can fade as a result of loss of job skill currency, personnel turnover, wear and tear on equipment, and age.

The current readiness and sustainment (the ability to maintain the necessary level and duration of operational activity to achieve military objectives) assessment methods focus on inputs and/or the availability of specific reserves or conditions from two separate and distinct sources, the service and the combatant command (Snyder, Dieryck, Long, Philipkosky, & Reis, 1996). Figure 14 depicts the current assessment system.



**FIGURE 14. Current readiness and sustainment assessment system  
(From Snyder et al., 1996)**

As shown, the status of resources and training system (SORTS) reflects current levels of military readiness. SORTS generalizes a unit's military readiness based on the lowest rating in five areas. Most commanders view the SORTS C-Rating (its measure of current readiness) as a report card of whether the unit can accomplish its wartime mission at its designed operating capability. Using this method, mission tasks (and the training requirements they generate) are essentially static, and commanders have little ability to redirect resources in the short term for contingency operations. For sustainment, stockpiled assets are given an S-Rating. The only assessment of output (desired capability) in both readiness and sustainment methods relies too much on the *subjective* judgment of commanders and decision-makers based on inputs they receive.

Limited data available, private agendas, faulty interpretations, and other human frailties ensure an assessment fraught with potential inconsistencies and inaccuracies, thereby potentially leading to ineffective and wasteful force management. Further, because of the disconnect at lower levels, C-Ratings and S-Ratings do little to convey the *true* capabilities of the military at the unit, joint force, and national level (Snyder, Dieryck, Long, Philiposky, & Reis, 1996).

Accurate, valid, and reliable criterion measures are needed to assess unit performance and readiness. The following sections will describe various ways in which the AF tracks and records training and readiness levels of its units.

## Status of Resources and Training System

SORTS is the DoD's automated reporting system that identifies the current level of selected resources and training status of a unit – that is, its ability to undertake its assigned wartime tasking (AFI 10-201; GAO/NSIAD-96-194, 1996; Snyder, 1995). The DoD has over 10,000 units that report readiness status under SORTS. Units report their overall readiness status as well as the status of four resource areas (personnel, equipment and supplies on hand, equipment condition, and training). Overall readiness status is generally reported at a level consistent with the lowest rated resource level, but commanders are allowed to subjectively upgrade or downgrade the overall rating. SORTS is an internal management tool used by the Chairman of the Joint Chiefs, services, and combatant commands. It provides the Chairman with the necessary unit information to achieve an adequate and feasible military response to crisis situations and participate in the joint planning and execution process.

The four resource areas of SORTS are reported on monthly or as changes occur in the unit (Junor & Oi, 1996). Any shortfalls must be fully documented. Readiness status of a unit is reported by assigning Category level ("C" level) that reflect the commander's subjective and objective evaluation based on specific criteria for manning, qualification, and training, spare parts, and equipment (GAO/NSIAD-96-194, 1996; GAO/T-NSIAD-97-107, 1997). The C-Level ratings are defined in Table 4.

**TABLE 4. Overall C-Level Rating and Corresponding Capability**

C-Level	Description
C-1	Possesses required resources and is trained to undertake the <i>full</i> wartime mission for which it is organized or designed. (90 - 100% ready)
C-2	Possesses required resources and has accomplished training necessary to undertake the <i>bulk</i> of its wartime mission for which it is organized or designed.
C-3	Possesses required resources and has accomplished training necessary to undertake <i>major portions</i> of its wartime mission for which it is organized or designed.
C-4	Requires additional resources and/or training to undertake its wartime mission, but if the situation dictates, it may be required to undertake portions of the mission with resources on hand.
C-5	Unit is undergoing a service-directed resource change and is not prepared to undertake its wartime mission.

*Note:* Adapted from *Military Readiness: Data and Trends for April 1995 to March 1996* (GAO/NSIAD-96-194, 1996) and *A Methodology for Establishing Maximum Aircraft Combat Turn Rates* (Dudley & Novotny, 1994).

In viewing SORTS information, it should be noted that there are significant differences in the way each service manages readiness (GAO/NSIAD-96-111BR, 1996; GAO/NSIAD-96-194, 1996). For example, the AF's goal is to maintain all units at the C-2 level or better. In contrast, the Army uses a tiered resourcing system that maintains contingency units at the C-1 or C-2 level but allows later-deploying units to fall to the C-2 or C-3 level. The Navy and the Marine Corps manage readiness so that deployed units are C-1 or C-2. Units deployed or preparing for deployment have higher resource allocation priority than non-deployed units. Therefore, reported readiness fluctuates with deployment and maintenance cycles.

The SORTS system attempts to measure four areas: (1) personnel, (2) equipment and supplies on hand, (3) equipment condition, and (4) training (Snyder, 1995). Within each area, commanders identify critical elements. If a unit could not maintain any or all of its assigned critical elements in the right quantity or quality, the commander identifies this area as a shortfall and that could affect the "C" rating of the unit. Within the AF, aircraft maintenance has much to do with maintaining high readiness ratings. Maintenance personnel must be available and trained to maintain the aircraft in a ready state, they must have the equipment and spare parts to accomplish their repair, and the equipment must be maintained in a quality state to allow immediate use for a variety of related missions.

The General Accounting Office (GAO) reported (GAO/NSIAD-96-111BR, 1996; GAO/NSIAD-96-194, 1996; GAO/T-NSIAD-97-107, 1997) that commanders sometimes upgrade the overall readiness status of their units over the rating the data would project. AF officials said they consider this SORTS upgrade feature to be a strength of the system. It is believed that a commander is in the best position to accurately assess the readiness of a unit on the basis of a wide range of information available to make this judgment. Further, the GAO (GAO/NSIAD-96-105, 1996) reported that SORTS does not capture all the factors that DoD considers critical to a comprehensive readiness analysis, such as operating tempo and personnel morale.

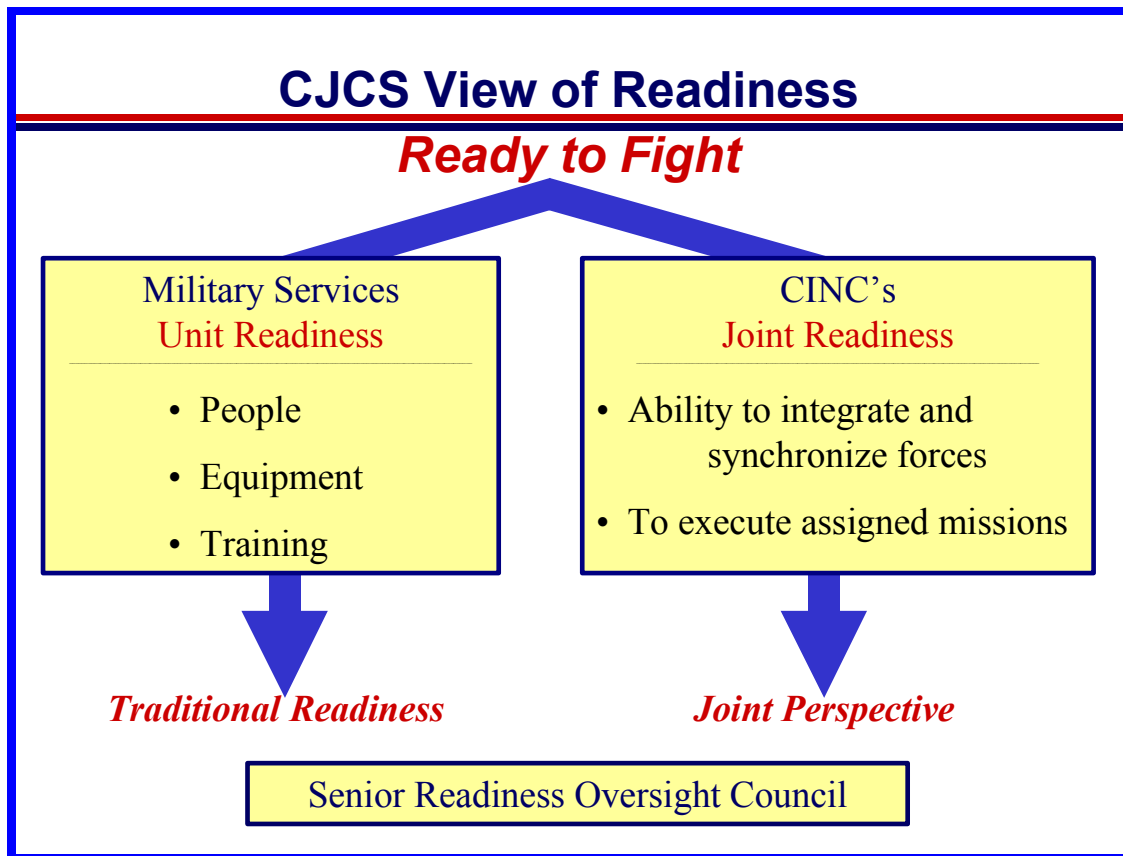
Table 5 shows a list of AF readiness indicators used by the GAO in their studies on military readiness (GAO/NSIAD-96-105, 1996; GAO/NSIAD-96-111BR, 1996; GAO/NSIAD-96-194, 1996). Further, Appendix E shows a matrix comparing MOEs/MOPs with SORTS items.

**TABLE 5. Readiness Indicators for the US Air Force**

<b>Air Force SORTS Data</b>	
•	Overall C-level rating
•	Personnel P-level rating
•	Equipment and supplies on-hand S-level rating
•	Major equipment condition S-level rating
•	Training T-level rating
<b>Air Force-Unique Indicators</b>	
♦	Percentage of:
•	authorized personnel available
•	critical authorized personnel available
•	authorized crews formed, mission-ready, and available
•	authorized combat-essential equipment and supplies on hand
•	authorized support equipment and supplies on hand
•	possessed combat-essential equipment that was mission-ready and available within unit's response time
•	possessed support equipment mission-ready and available within unit's response time
<b>Calculations Using Air Force SORTS Data</b>	
♦	Percentage of
•	total authorized personnel assigned
•	total authorized critical personnel assigned
•	total authorized crews formed, mission-ready, and available
•	total authorized crews formed from assigned individual personnel
•	authorized combat-essential equipment assigned
•	authorized combat-essential equipment on hand
•	authorized combat-essential equipment mission-ready and available
•	assigned combat-essential equipment mission-ready and available
•	possessed combat-essential equipment mission-ready and available

*Note:* From *Military Readiness: Data and Trends for April 1995 to March 1996* (GAO/NSIAD-96-194, 1996).

A SORTS upgrade was recently implemented and renamed global status of resources and training system (GSORTS) (Snyder et al., 1996). This system communicates SORTS data over the Global Command and Control System (GCCS). Snyder et al. state that these ongoing improvements to the current methods, as well as to the next generation of readiness and sustainment assessment methods, fall short of providing an accurate and predictive measure of military capabilities at all levels. As shown in Figure 15, military readiness assessment still relies on stovepipe reporting (refers to the lack of information cross-flow between the two systems), as well as considerable subjective input. This lack of integration limits the quality of decisions regarding competing priority trade-offs (Snyder et al., 1996).



**FIGURE 15. Chairman, Joint Chief of Staff's view of readiness  
(From Snyder et al., 1996)**

These systems rely heavily on *subjective* input. Subjective evaluation of the line commander is an important element of a useful reporting system, but the manipulation of subjective readiness evaluations for political or other non-combat purposes should be minimized (Snyder et al., 1996). It is believed that the current readiness system is used by commanders, staff officers, and politicians to fight resource allocation battles and that today's military leaders and civilian decision-makers are faced with a unique set of socio-cultural problems when attempting to measure and assess military readiness objectively (Snyder et al., 1996).

#### ***Air Force Integrated Readiness Measurement System (AFIRMS)***

AFIRMS is an automated, tasking based, capability assessment system (SofTech, 1985). This system evaluates unit and force capability to perform tasked missions based on resource availability. AFIRMS provides a tool for calculating long-term readiness and sustainability trends, spanning two to six fiscal years. This permits comparison of readiness and sustainability by fiscal year and can highlight the impact of changes to the unit.

Determining the force's ability to perform is the essential function of AFIRMS. The tasking and resource data collected are processed to determine how much tasking can be accomplished with the available resources. Ability-to-perform is evaluated in terms of the task metric (missions, sorties, etc.) and the cost metric (dollars) to provide readiness/sustainability and dollars information to readiness assessments (SofTech, 1985).

## ***Joint Service Readiness Measurement and Display Systems***

Joint tasks describe in broad terms the capabilities of the Armed Forces of the United States. Joint tasks are those assigned by joint force commanders to be performed by integrated Service components (CJCSM 3500.04A, 1996). The following sections describe some of the measurement systems used to assess the readiness of the Joint Services. These systems are often used as either supplements to SORTS, or as more detailed references to readiness criteria.

### ***Joint Readiness Automated Management System (JRAMS)***

JRAMS allows high-level planners to assess current availability and preparedness of any combination of forces or supplies. Data used to determine readiness comes from a variety of databases and is graphically displayed in a way that allows the planner to have total force visibility and then assess the impact of one plan against another. This information, which previously had to be retrieved and tabulated, is now available from a single JRAMS interface. Every time a user requests an update on force readiness, JRAMS queries the databases, assimilates the data and performs calculations, then updates the information on the graphical display (Gillis, 1996).

### ***Universal Joint Task List (UJTL)***

The UJTL contains (1) a comprehensive hierarchical listing of tasks that can be performed by a joint military force, (2) a common language of conditions that is used to describe the operational context in which tasks are performed, and (3) a list of MOPs for each UJTL task (CJCSM 3500.04A, 1996). These MOPs are used to develop required standards of performance to meet mission requirements. The UJTL does not address “how a task is performed,” or “who performs the task;” it does however identify “what is to be performed” in terms common to multiple combatant and joint force components (CJCSM 3500.04A, 1996, 1996).

***Application of the Universal Joint Task List.*** As applied to joint training, the UJTL is a key element of the requirements-based, “mission-to-task” joint training system. In this system, commanders examine their mission and document their command war-fighting requirements in a Joint Mission Essential Task Lists.

***Joint Mission Essential Task Lists (JMETL).*** Current readiness assessment is unit-based and cannot answer questions about the ability to perform specific missions. To make mission-based assessments, task-based performance data is required. Task-based assessment data, containing information on the mission context in which it was collected (conditions information) and based on results-oriented MOPs from the UJTL, can be used to determine the readiness to perform a particular mission. If task performance in one mission context can be translated to other mission contexts after-the-fact (adjusting for differences in conditions), then “constructive” assessments can be made of mission readiness. The JMETL process provides the capability for making such translations (Wagner, 1996).

A JMETL specifies the task to be performed, under what conditions, and to what standard using the common language provided in the UJTL. JMETL provides the basis for conducting joint training and for generating task-based assessment data. (A more detailed discussion of the UJTL and JMETL is provided in Section 2)

### ***Joint Automated Readiness System (JARS)***

JARS is being designed as a supplement to access SORTS and other readiness-related data and uses pre-established rules to account for readiness in three environments: (1) tactical unit readiness, (2) operational theater readiness, and (3) strategic (national) readiness. This is a comprehensive effort to improve the way readiness information is shared and analyzed (Neal, 1996).

### ***Readiness Baseline (RBL) Indicators Project***

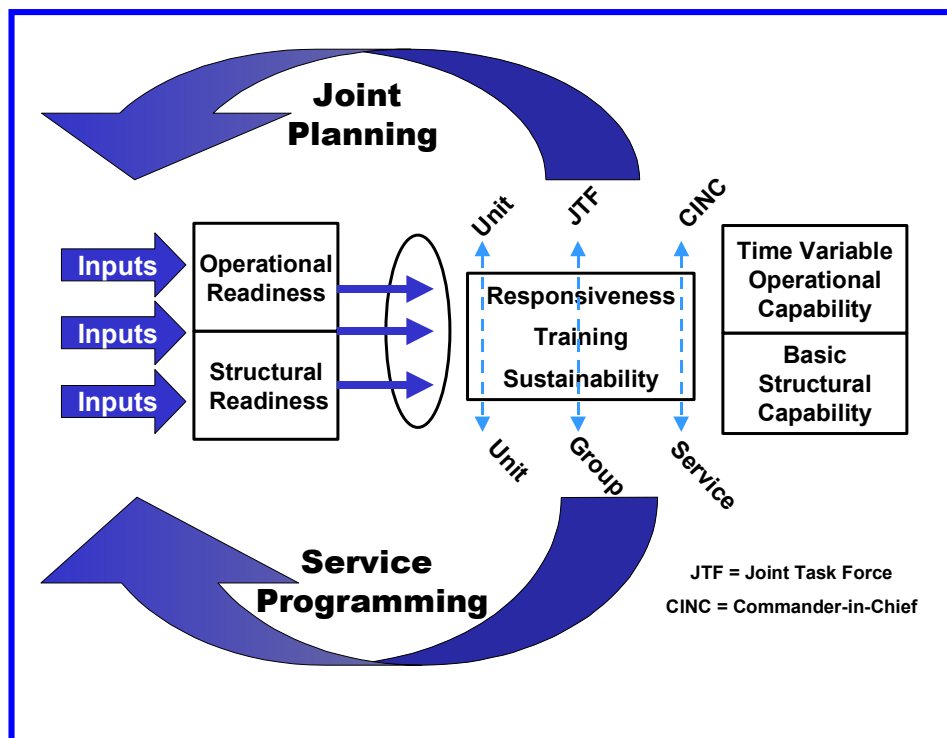
The RBL project is developing a comprehensive set of readiness indicators, which may be used to understand, predict, and prevent readiness shortfalls (Medlock, 1996). The RBL will be used to assist in current readiness assessments, to synchronize readiness-related budget data, and to participate effectively in the public discussion of the Armed Forces readiness posture.

The RBL framework addresses both unit readiness and joint readiness. Unit readiness is structured into three functional areas: personnel, equipment, and training. Joint readiness is structured into two categories: deployment and employment.

### ***Joint Readiness Assessment and Planning Integrated Decision System (JRAPIDS)***

The effective management of the joint air and space forces of the future demands an output-focused, integrated systems approach to readiness assessment to obtain the optimal readiness combination of when, what, and where (Snyder et al., 1996). As illustrated in Figure 16, JRAPIDS is a proposed computerized data system designed to measure both operational and structural readiness in terms of assessing, judging, and predicting the impact of all factors in the following areas (AETC, 1996a; Snyder et al., 1996):

- **Responsiveness** - the promptness in preparing for the task at hand.
- **Operational training** - flexible training in the field that allows for preparing for new tasks in new environments.
- **Sustainability** - required endurance in performing a particular military task.



**FIGURE 16. JRAPIDS: A holistic method for determining future force capabilities (From Snyder et al., 1996)**

JRAPIDS will provide a new approach to readiness and sustainability measurement with a new set of components and processes:

- **Measurement of Output** - JRAPIDS must measure unit and force capability as a function of time versus merely computing assets on hand. It will answer the question, “readiness and sustainability for what?” JRAPIDS must be capable of assessing actual performance levels of all resources within the unit and it must provide an aggregate, scalable performance indicator for the unit as a whole. It must also be able to provide an overall performance potential assessment for joint and national level forces.

- Practical - JRAPIDS must be easy to use and inexpensive to operate. Said another way, “The job of measurement should stay extremely small compared with the jobs of providing readiness and sustainability.” Moreover, the information provided by JRAPIDS must be easily understood and easily interpreted by all users and decision-makers, throughout the chain of command.
- Objective - JRAPIDS must be objective and verifiable to ensure accurate measurements. A few subjective judgments will still be required for personal insights such as morale levels or any other judgment requiring a high degree of human intuition. The key is that these should be limited in order to lessen the impact of incorrect assessment. Furthermore, system protocols should prevent penalties for lower-level commanders whose readiness levels are low for reasons beyond their control. This also imbues an attitude of truthful assessment.
- Robust - JRAPIDS must be capable of assessing readiness and sustainability across a wide range of contingency operations and real-world circumstances thus allowing accurate measurements in the face of unforeseen events. It must also assess readiness levels at all times, whether the unit is deployed or not. This implies the requirement for real-time or near-real-time update capability.
- Useful - JRAPIDS must provide useful feedback to the lowest level of data providers. Units must be able to determine if actions taken to correct shortfalls have positively affected readiness rates. Additionally, the system must tailor the output to each level of command. For instance, the information required by a joint force commander is different from that required by a service component commander. Due to the complex nature of this system and the existence of this feedback loop, decision-makers must ensure that the effects of chaos do not impede system operation.
- Comparable - JRAPIDS must be capable of providing objective comparisons of readiness and sustainment levels from one year to the next. This allows decision-makers to base effective trade-off decisions on factual historical data rather than on subjective assumptions.
- Comprehensive - JRAPIDS must be able to assess peacetime activity rates of resources and relate them to military operational ability. The intent is to accurately predict the resource implications during the transition from peace to war. This also allows the continuous monitoring of the effects of peacetime operating tempo (OPTEMPO) and personnel tempo (PERSTEMPO) on operational readiness and combat sustainability.
- Secure - As a global information system possessing critical data on US military capabilities, JRAPIDS will be a prime target in any future information war. Therefore, system security will be an essential requirement.
- Trade-off Evaluation - JRAPIDS must allow trade-off comparisons between resource categories as well as between the categories of military capability. The intent is to provide a system that can identify when too much emphasis in one area adversely impacts other areas of military capability. A key feature of JRAPIDS will be the assessment of the impact to the overall force’s capability as units are deployed, in transit, or re-deployed.

[Snyder et al., 1996, pp.11-12]

JRAPIDS will seek to provide 21<sup>st</sup> century commanders with a more comprehensive understanding of total force readiness and potential trade-off benefits available in making different decisions (AETC, 1996a; Snyder et al., 1996). The ability to possess such a system for readiness and sustainment measurement increases commanders’ awareness of their own forces and assets rather than those of the enemy or the strategic environment in general. Having an integrated system such as JRAPIDS for measuring, adjusting, and forecasting readiness and training will help provide the USAF with a comparative advantage over its adversaries.

JRAPIDS will automatically update the readiness status of individuals, units, and forces (active, guard, and reserve) while providing decision-makers a comprehensive measure of readiness and sustainment that focuses on outputs (AETC, 1996a; Snyder et al., 1996). The final product consists of a time-variable, mission-scaleable matrix depicting capability available over time in a given theater of operations for a specific task or mission. This provides decision-makers with an overall force management capability. Such a complex data collection, processing, and management system is possible through the merging technologies of artificial intelligence and increased computing and communications capabilities (AETC, 1996a; Snyder et al., 1996).

## **5. Evaluation Criteria**

Trained people are a critical resource necessary for organizations to accomplish their missions. In evaluating training applications, it is important to note the effectiveness of the training as it relates to the performance of the trainee. Does the training provided help the trainee to meet particular guidelines or levels of performance set by commanders or by the AF missions? Training evaluations provide commanders with information to determine how well a specific training course or program has met its objectives (how effective was the training?). This determination is essential in establishing return on investment by justifying the expenditure of training funds to improve work quality, quantity, timeliness, productivity, or management operations (AFI 36-401, 1994). MPT scientists have limited access to operational data, and most of the available data is hardware-oriented, rather than human-performance-oriented. At best, the operational data is confounded with a mixture of hardware and human performance captured in the same measure. Thus, to MPT scientists, these operational data may seem irrelevant or intractable. MPT effectiveness measures need to be linked to war-fighting capability measures. To help clarify the criteria, this section will address two types of mission effectiveness evaluation measures: MOEs and MOPs.

### ***Defining Criteria***

#### ***Effectiveness and Performance***

In casual usage, the terms ‘effectiveness’ and ‘performance’ may be treated as if they were synonymous. However, those who measure weapon systems prefer to differentiate between effectiveness and performance. Effectiveness relates to objectives, and performance is more associated with the mechanics. Effectiveness is defined as: how well a system (human or otherwise) achieves its objectives in agreement with some established criteria, generally construed to be quantitatively related to its organization and application (Eisenhardt, Eisenhardt, & Douthat, 1985). Performance is defined as: the degree to which a system achieves its objectives; how a system performs “mechanically” (Eisenhardt et al., 1985). To assess unit and mission effectiveness, performance has to be measured within a framework of established doctrine (Hiller, 1994).

#### ***MOEs and MOPs***

MOEs and MOPs are both measures of mission effectiveness. For example, a commander may judge a mission successful by looking at the “Number of Kills per Sortie.” From a training standpoint, is there a way to better train the pilots to meet this MOE? The same measures used by commanders can also be linked to training effectiveness in that they can provide a level of effectiveness needed to perform in the field. If trainers are aware of what the commanders are looking for in a successful mission, they can provide the proper training to meet those goals.

Although a distinction between MOEs and MOPs is often made, there appears to be a great deal of overlap and interchangeability between MOEs and MOPs (Lane, 1986), with some MOPs being labeled as MOEs; therefore, we refer to MOEs and MOPs in a combined manner (i.e., MOE/MOP) throughout this paper. This confusion comes from the fact that a top-level MOE (e.g., “Sortie Generation Rate”) can also be an MOP for a different MOE (e.g., “Availability and Sustainability”). The true nature of the measure, be it an MOE or MOP, depends on the level at which the system is being evaluated. The

theory of organic wholes – “Holism” – emphasizes the relationship between parts (e.g., MOPs) and wholes (e.g., MOEs) and underscores the need to understand the inter-connections between parts and wholes.<sup>2</sup> For this reason, we refer to MOEs and MOPs with a slash between them (i.e., MOE/MOP) throughout this paper.

**MOEs and the “Total System.”** MOEs are the criteria for determining the “goodness” of a system (i.e., utility and effectiveness). Because AFOTEC focuses on total system performance, and since the “total system,” as defined by DoD Directive 5000.1 (DoD, 1996a; p. 5), includes “the people who operate and maintain the system” and their “training and training devices,” the broader definition of “total system” MOEs/MOPs would include the effectiveness of units, teams, or crews, and individual performance associated with the system. MOEs are typically a measure of how well an operational task, or operational task element, is accomplished, by a system (ordinarily a single operator using one aircraft or weapons system to perform one task) (AFOTEC 99-101, 1995; Lane, 1986; AFI 99-103, 1994).

**Operational Task.** An “operational task” is an individual military operation accomplished in support of a regional operational objective. To simplify, operational tasks are “actions to be accomplished” and do not identify what system is used for the task’s accomplishment. The units, organizations, or individuals who perform assigned tasks in support of operational tasks are called “Operational Task Elements” (AFOTEC 99-101, 1995).

**Operational Task Example:** For example, in the case of the operational task “destroy the runway at Airbase A,” success or failure is measured from the perspective of the customer—the Commander-in-Chief (CINC) or Air Component Commander and their staff. The MOEs measure how well the job was done, and they can be expressed in a variety of forms: the number of sorties required to destroy the runway, the percentage of times the runway was destroyed, etc. There can be more than one MOE associated with any given task (AFOTEC 99-101, 1995).

**MOPs.** MOPs are measures of system capabilities or characteristics (AFI 99-103, 1994). They indicate the degree to which that capability or characteristic performs or meets the requirement under specific conditions (AFI 99-103, 1994). MOPs are components, or subsets, of MOEs; i.e., the “degree-to-which” (MOP) a system performs is one of a number of possible measures of “how well” (MOE) a system’s task is accomplished. Therefore, MOPs can be accumulated to assess an MOE that is not directly measurable (AFOTEC 99-101, 1995). For example, the MOP, “Preparation and Reconfiguration Times for Air Transport” can be linked to the MOE, “Measured Loader Availability to Support Aerial Port Operations” (AFOTEC 99-101, 1995).

### ***Categories of MOEs/MOPs.***

MOEs/MOPs can be roughly classified as falling into one of four categories formed by the interaction of two separate measurement distinctions. The first distinction that can be made is the quantitative-qualitative dimension (AFOTEC 99-101, 1995; AFI 99-103, 1994). Quantitative measures refer to indices that can be specified on a numerical (interval or ratio) measurement scale and they capture the degree to which the system can perform (how far, how fast, how high, etc.). Qualitative measures are categorical variables that do not imply any numerical value and more often refer to the presence or absence of some characteristic or event. Quantitative measures typically cost more to collect than qualitative measures. Qualitative measures can be collected by simply demonstrating that the system is capable of possessing a certain attribute. Quantitative measures, therefore, require repeated data collection events and a large enough sample size to capture the performance relative to variability (AFOTEC 99-101, 1995).

The second distinction is the objective-subjective dimension. Objective measures are independent of judgment or opinions of a human data collector. Subjective measures rely on the judgment of a human participant. The term “quantitative” is often confused with “objective,” and

---

<sup>2</sup> A detailed discussion on Holism is beyond the scope of this report. For more information, see Koestler, A. (1979). *Janus: A summing up*. New York: Vintage Books.

“qualitative” is often mistakenly used instead of “subjective.” Table 6 attempts to clarify confusion associated with these terms.

**TABLE 6. Classification of Measures.**

Classification of Measures		
	Quantitative	Qualitative
Objective	<i>Objective-Quantitative</i> Examples: Average airspeed Maximum detection range.	<i>Objective-Qualitative</i> Examples: Demonstrated communications connectivity. EMP/HEMP survivability.
Subjective	<i>Subjective-Quantitative</i> Examples: Rating of workload and fatigue. Average number of crew errors.	<i>Subjective-Qualitative</i> Examples: Test team judgment on capability to land at austere airfield.

\*Source: Adapted from AFOTEC (AFOTEC/XRC). (1995). AFOTECH 99-101, *Test Concept Handbook*, Jan 95. Kirtland AFB, NM: Author.

The first category, objective-quantitative measures are “hard data” that can be counted, timed, or weighed with some mechanical or digital apparatus. Examples include “Speed of Aircraft,” “Average Weight per Payload,” or “Number of Hits” on some target or range. (Note: Sometimes these measures become subjective when judgment is used to determine if a “hit” is a “kill” or a mission is a “success.”).

The second category, objective-qualitative measures, typically involves a “demonstrated capability” or a one-time check the system possesses a given characteristic. For example, verifying the communication system has connectivity to all required locations or nodes typically requires measuring a positive connection only once at each location, a demonstration rather than a mission-representative scenario (For this reason, objective-qualitative measures are more often associated with development test and evaluation.). The third category, subjective-quantitative measures, provides examples of measures that include ratings by observers with a data collection checklist or test participants completing a well-designed rating scale questionnaire. For these sorts of measures, care is taken to ensure that the resulting data are on interval or ratio scales of measurement prior to statistical analysis. Finally, subjective-qualitative measures are typically yes/no judgments made by test participants (AFOTECH 99-101, 1995). MAJCOMs must take into consideration several measures to ensure that the missions set forth are adequately and accurately accomplished. They must take into account the primary missions, air tasks, and air subtasks (Table 7). For example, one of ACC’s primary missions is counterair. One air task in this mission is offensive counter air, which has subtasks of attack, fighter sweep, air escort, and Combat Air Patrol. AMC has primary missions including strategic and tactical airlifts, aerial refueling, and advanced flight training. The primary mission of AFSOC is to provide special air operations, with tasks involving unconventional warfare, foreign international defense, and psychological operations. The AETC’s aeronautical missions are centered on undergraduate pilot training and initial system-specific pilot training.

**TABLE 7. Major Commands and Categories of Missions**

<b>Air Combat Command (ACC) Missions:</b>		
<i>Primary Missions</i>	<i>Air Tasks</i>	<i>Subtasks</i>
Counter Air	Air Superiority	Gain Control of Air
	Offensive	Target/Attack Airborne Enemy Threats Fighter Sweep Combat Air Patrol Air Escort
	Defensive: Passive	
	Defensive: Active	Maintain Control of Air Maintain Constant Readiness Maintain Continued Sustainability Intercept Detect Airborne Enemy Threats Combat Air Patrol Barrier Combat Air Patrol SAM Engagement Air Escort
Strategic Attack/Interdiction (SA/I)* <i>(*Will be replaced by "Force Application" in FY98.)</i>	Precision Employment	Support sortie production.
	Attack	Destroy/damage/suppress mobile SAMs/TELS/AAA/directed energy weapons. Destroy/damage ballistic missiles/launchers/TELS on the ground. Provide self-protection. Destroy/damage/delay advancing combat forces. Destroy/disable fixed forces. Deny use of runways & taxiways. Destroy/damage/suppress fixed SAMs/TELS/AAA/directed energy weapons. Destroy/damage/suppress national C <sup>4</sup> I. Destroy/neutralize/deny access to Weapons of Mass Destruction (WMD) storage and production.
Theater Missile Defense (TMD)	Air Superiority	Destroy Cruise & Ballistic Missiles inflight.
	Attack	Destroy Theater Missile on the ground.
	Command & Control	Provide Real Time Command & Control.
Strategic Air Defense	Air Superiority	Destroy/damage/neutralize air vehicles in flight. Control airborne missions. Assess theater operations. Provide TW/AA of ballistic missile & air attack. Train mission ready personnel. Respond & prepare for execution.
	Defensive: Active	Detect/identify/monitor situation. Provide command & control networks. Provide intelligence. Sustain efficient operations. Preposition equipment & supplies. Plan & adjust theater air plan.
Close Air Support (CAS)* <i>(*Will be replaced by "Force Application" in FY98.)</i>	Precision Employment	Conduct/coordinate airborne air-strike terminal control.
	Attack	Destroy/disable/neutralize engaged combat forces.
Air Surveillance & Reconnaissance	Information Dominance	Assess operations: Provide indications & warning. Sustain efficient operations.
	Visual Photo Imagery	Detect/Identify/Monitor Situation: Provide surveillance & reconnaissance.
	Electronic	Provide intelligence support directly to the warfighter.
Electronic Warfare (EW)	Information Dominance	Counter the threat.
	Attack	Reactively suppress surface-to-air threats. Preemptively destroy surface-to-air threats. Deny acquisition.

Air Combat Command (ACC) Missions:		
Primary Missions	Air Tasks	Subtasks
	Protect	Detect & Warn. Collect signals.
	Support	Reprogram.
Single Integrated Operational Plan (SIOP)	Fixed Targets	
	Relocatable Target	Predictable/Unpredictable
Contingency Base Operations	Readiness & Sustainment Nuclear Conventional	Provide contingency operating locations. Defend contingency operating locations. Recover contingency operating locations
Rescue	Readiness & Sustainment	Locate downed crewmembers (survivor). Communicate with the survivor & command & control assets to coordinate a recovery.
	Recovery	Recover the survivor by penetrating the threat, day or night & in adverse weather conditions.
Maritime		
Illegal Drug Traffic Interdiction	Monitoring & Interception	Support the US Drug Enforcement Agency (DEA) & US Customs Agency in controlling illegal drug traffic entering the US.
Ferry		
Training for ACC Aircraft	Advanced Flight Training	Includes initial, upgrade, requalification, & recurring using aircraft, simulators, & part-task trainers.
Theater Battle Management (TBM)	Information Dominance	Collect/disseminate mapping data on area of operations. Locate/communicate/recover downed aircrews/isolated personnel. Provide/Protect C <sup>2</sup> I networks & systems. Detect/identify/monitor theater situation/provide R & S.
	Establish/maintain effective battle management	Assess theater operations/Provide indications & warnings. Plan/adjust theater operations plan. Respond to taskings/Prepare for execution. Control alert/airborne missions. Provide self-protection for air vehicles. Pack/con /assemble (for movement) people/equipment/etc. Replenish/resupply munitions, equipment, tools, spares, consumables, technical data, POL.
Counter Information/Information Warfare (IW)	Offensive Counter Information (OCI)	Enables AF to use the information realm & impedes the adversary's use of the realm.
	Defensive Counter Information (DCI)	Establish, maintain & conduct protective security measures of friendly information systems and procedures.
	Information Dominance	Conduct EW operations. Conduct physical destruction of selected enemy information systems.
	Maintain Constant Readiness	Conduct psychological operations. Conduct military deception operations.
Combat Delivery* (*1996 Corona decided to move this mission to AMC.)	Global Mobility Power Projection Force Sustainment	Movement of equipment, supplies, & personnel, including aeromedical evacuation through airland operations. Airdrop of equipment, supplies, & personnel to support theater forces.
Air Mobility Command (AMC) Missions:		
Primary Missions	Air Tasks	Subtasks
Airlift	Cargo	Airlift of supplies & equipment whose urgency cannot wait for surface transportation.
	Special Operations	Provides specialized strategic airland/airdrop support to special operations forces.
	Passenger	Provides airlift for combat troops & support personnel, troop rotations, & movement of the President and senior government or executive personnel.

	Airdrop	Unloading of personnel or material from aircraft in flight.
	Aeromedical Evacuation	Rapid worldwide transportation of ill or injured personnel to appropriate medical care.
Aerial Refueling	Deployment & Redeployment	Allow for rapid deployment of fighters, bombers, & combat support aircraft.
	SIOP	Air refueling for bomber force generation, execution, employment, & subsequent bomber survival, recovery, & reconstitution.
	Employment of Conventional Forces	Support combat air forces by expanding both reach & power of the aircraft.
Training for AMC Aircraft	Advanced Flight Training	Includes initial, upgrade, requalification, & recurring using aircraft, simulators, & part-task trainers.
<b>Air Force Special Operations Command (AFSOC)/Special Operations Forces (AFSOF) Missions:</b>		
<b>Primary Missions</b>	<b>Air Tasks</b>	<b>Subtasks</b>
Special Operations (SO)	Direct Action (DA)	Seize, destroy, or inflict damage on a specified target. Destroy, capture, or recover designated personnel &/or material.
	Special Reconnaissance (SR)	Obtain or verify, by visual observation or other collection methods, information concerning the capabilities, intentions, & activities of an actual or potential enemy. Secure data concerning the meteorological, hydrographic, geographic, or demographic characteristics of a particular area. Target acquisition, area assessment, & post-strike reconnaissance.
	Unconventional Warfare (UW)	Guerrilla warfare, subversion, evasion & escape, sabotage, & other operations of a low visibility, covert, or clandestine nature.
	Foreign Internal Defense (FID)	Train, advise, & assist host nation military and paramilitary forces.
	Counterterrorism (CT)	Apply specialized capabilities to preclude, preempt, & resolve terrorist incidents abroad.
Psychological Operations (PSYOP)	Support the FID	Targeting insurgents, local populace, military forces, & neutral forces; helping discredit insurgent forces, & strengthening support for the host nation.
	Support UW	Reaching out to resistance sympathizers & the uncommitted & by targeting hostile military forces & their sympathizers to achieve certain psychological effects in support of SO objectives.
	Play a key role in DA, SR, CT actions	Effective PSYOP could maximize the psychological impact of successful operations & minimize the adverse impact of failed or compromised actions.
Collateral SO Activities	Security Assistance	Provide mobile training teams & other forms of training assistance.
	Humanitarian Assistance	Promote nonmilitary objectives within a foreign civilian community. These objectives may include disaster relief, medical, veterinary & dental aid, rudimentary construction, water & sanitation assistance, & support to, or resettlement of, displaced civilians (refugees or evacuees).
	Antiterrorism & Other Security Activities	Reduce the vulnerability of individuals & property to terrorism. Provide training & advice on how to reduce vulnerability to terrorism & other hostile threats. Evaluate the adequacy of existing physical security systems against potential threats. When directed, augment existing security forces to protect important persons, resources, & events.

Air Force Special Operations Command (AFSOC)/Special Operations Forces (AFSOF) Missions:		
Primary Missions	Air Tasks	Subtasks
	Counter-Drug Operations	Interagency activities taken to disrupt, interdict, & destroy illicit drug activities. The primary role is to support US & host nation counter-drug efforts abroad by advising, training, & assisting host nation military & paramilitary forces. When specifically authorized, assist police operations targeted at the sources of narcotics.
	Personnel Recovery	Required to recover isolated personnel whose recovery may be beyond capabilities of other theater combat rescue forces. Such personnel recovery missions would resemble DA operations. These are characterized by detailed planning, preparation, rehearsal, and thorough intelligence analysis. Could be tasked to recover downed personnel in conjunction with a SO mission.
	Coalition Support	May be required to provide liaison to coalition forces, thus facilitating interoperability.
	Special Activities	Activities conducted abroad in support of national foreign policy objectives. Normally conducted in such a manner that US Government participation is neither apparent nor publicly acknowledged.
Air Education and Training Command (AETC) Missions:		
Primary Missions	Air Tasks	Subtasks
Recruiting	Recruitment	Recruiting the young men & women needed to meet the demands of the AF.
Training	Military	Execution of basic military training & initial skills training.
	Technical	Execution of advanced technical training.
Flying Training	Basic Undergraduate Advanced Undergraduate	Complete training of combat aircrew members.
Education	Basic Technical	Emphasis on combination of education & training.

*Note:* Information adapted from Military Standard 1776A. *Aircrew Station and Passenger Accommodations*, 1994; USSOCOM. *AFSOC Weapon System Roadmap*, 1995; ACC/DR. *Mission Area Plans*, 1996; AETC. *AETC Missions*, 1996b; AMC/XP. *1996 Air Mobility Master Plan (AMMP-96)*, 1995; AMC/XP. *1997 Air Mobility Master Plan (AMMP-97)*, 1996; AFDD 35, 1995; and Mackenzie. *Modernization Planning Process*, 1996.

## 6. Sources of MOEs and MOPs

Below are sources of MOEs and MOPs used to measure combat and combat support effectiveness. These sources include measurements and criteria used in military exercises, wargames and simulations, military competitions, operational tests and evaluation (OT&E), operational readiness inspection (ORI), command briefings, military standards (MIL-STDs), unit quality metrics, mission area analyses and mission area plans, acquisition documents, readiness reporting systems, training and standard evaluation regulations, and the universal and mission essential task lists. Within each category of these sources, we have provided several examples, along with MOEs/MOPs derived from each area. The matrix in Appendix F provides a tabular view of parts of this section, along with listings of additional military wargames and exercises.

### **Military Exercises**

Military exercises use real aircraft in mock and simulated combat situations. These exercises are very costly, but offer a more “real” perspective of what can be expected in combat than simulations or discussion. Since these exercises require extensive planning and coordination, they are performed during scheduled events (e.g., Red Flag, Global Yankee); however, numerous exercises of various sizes are performed throughout the year. Some of these exercises involve maintainer participation while others focus only on operators. Many of the exercises by the AF are classified, at least until after they are conducted. Exercises are often scheduled to test and improve different mission capabilities. Each exercise involves these phases: planning, preparation, execution, and evaluation. Exercises are conducted

for the purpose of both training and evaluation (AFPD 10-2, 1997). The scoring criteria for the exercises are good indicators of the MOEs/MOPs that commanders and high-level decision-makers consider appropriate for evaluating war-fighting capability on the missions addressed by the exercise. The following sections describe various exercises performed by the AF and, when available, scoring criteria (MOEs/MOPs) are provided.



**Blue Flag.** Blue Flag has evolved from a live flying exercise into the world's largest computer-assisted modeling and simulation exercise, using software that allows both offensive and defensive activities to be executed simultaneously (AFNS, 1995c; AFNS 1996a). Blue Flag is conducted quarterly by the AF Battlestaff Training School, a subordinate unit of the AF Air Warfare Center. The exercise trains combat leaders and supporting battle staff in command and control procedures for specific theaters of operation, attempting to replicate theater conditions and procedures as realistically as possible (AFNS, 1995c). Blue Flag trains participants in the efficient and effective employment of air power (AFNS, 1996a). Those participating in Blue Flag come from a variety of AF bases, Army posts, Navy and Marine Corps bases, and Coast Guard facilities. Each Blue Flag uses a different theater of operation and scenario (AFNS, 1996a).

Participants begin with three days of academic and seminar training, followed by a four-day exercise using realistic friendly and enemy orders of battle, contingency plans, and theater procedures. The players are given maximum flexibility to manage the employment of friendly forces, allowing them to influence the battle outcome (AFNS, 1995c).

**Red Flag.** This exercise is a simulated combat training exercise involving the USAF and its allies, usually conducted at Nellis AFB, NV (Rusing, 1980). The mission of Red Flag is to maximize the combat readiness, capability and survivability of participating units by providing realistic training in a combined air, ground, and electronic threat environment while providing for a free exchange of ideas between forces (AFFWC/PA, 1992). Six exercises, each lasting six weeks, are conducted annually. Each exercise is further divided into 2 week periods which involve 85 to 100 aircraft that train approximately 300 aircrew and 1,000 support personnel (AFFWC/PA, 1992).

A typical Red Flag mission involves a simulated "Red Force" integrated defense system composed of mock SAM sites, targets, and aircraft defending the "Motherland" of the Red Flag ranges. The "Blue Forces" are composed of fighter-bombers (F-16s, A-10s, F-111s, F-15Es, etc.) whose mission is to attack assigned targets. For the fighter-bombers to be successful against the integrated "Red Force," air superiority aircraft (F-15s F-14s, F-16s, F-18s, etc.) and electronic combat aircraft (F-4Gs, AWACSS, EF-111s, etc.) are needed. During missile firings, the computer generates a simulated fly-out on the computer display. Since the computer knows the target's flight parameters, it can determine if the missile shot was valid by displaying the probability of kill. The computer is also capable of determining an estimated point of bomb impact for the fighter-bombers not actually carrying ordnance, known as "No-Drop Bomb Scoring" (AFFWC/PA, 1992). Examples of MOEs/MOPs focused on during Red Flag include "probability of kill" and "bombs on target."

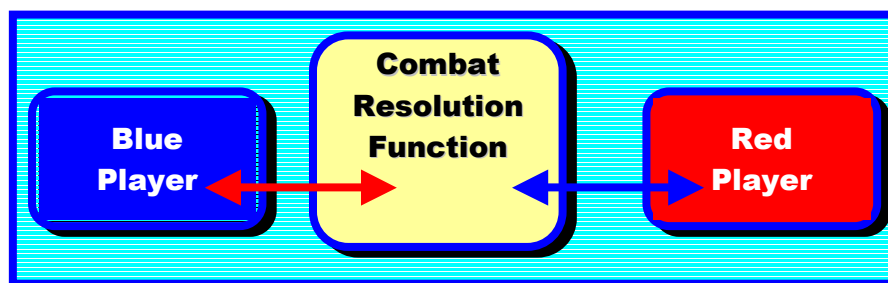
### **Wargames and Simulations**

Wargaming, the non-destructive simulation of armed combat, is the study of how to successfully wage war, given available resources. Wargaming involves a replication of warfare without actual combat, allowing opponents to repeatedly respond to each other's varied attacks. Military wargames and simulations are used worldwide to allow military commanders to practice strategies, maneuvers, tactics, and decision-making skills under conditions which give them time to consider options. By studying the results, war-fighters can improve their combat skills and, using this knowledge, can become more likely to win. As with the military exercise, simulated wargames are carried out for the purpose of training and evaluation. The MOEs/MOPs that commanders and high-level decision-makers consider appropriate for evaluating war-fighting capability are found in the scoring criteria of the wargames.

Until the 20<sup>th</sup> century, wargames were relatively simplistic. Now, wargames can represent an extremely sophisticated array of combat systems and events. Modern simulated wargames include computer systems to provide a representation of modern combat that contains air, land, and sea forces interacting on a broad scale. Such interactions require computers and sophisticated software to provide a representative simulation of war. These new models are able to communicate between themselves, which provides enhanced simulations that can be coupled in one wargame to exercise joint and combined military capabilities. As wargaming with computers has become complex, specialized military organizations have emerged to run them, one of which is the Warrior Preparation Center (the Warrior Preparation Center [WPC], 1996).

An interactive computer-assisted exercise (CAX) is a computer-driven wargame for training and exercising wartime staff functions. During an interactive CAX, commanders execute their war plan against a thinking opposing force, providing subordinates with appropriate orders and guidance, while communicating with their peers and higher headquarters. Staff members employ their wartime procedures and functions, creating and reacting to situations as they develop (WPC, 1996). A CAX is a dynamic and non-destructive exercise where computers resolve conflicts. CAX and other types of exercises provide training at various levels; however, CAX is the only practical means of practicing operational level warfare (WPC, 1996). As well as solving problems, CAX presents significant advantages over field exercises. The most important is realism. CAX allows high level staff to realistically and thoroughly exercise almost all their wartime functions, while in a standard live exercise dangerous functions are usually not performed. With a CAX, actual weapons systems are not used but are replaced with simulations (WPC, 1996), providing simulated realism.

The AF has realized that computer-based wargames are a comparatively cost-effective way to provide valuable training and education in force coordination and employment (Goehring, 1993). In wargames and simulations, no actual materials (aircraft, fuel, weapons, etc.) are used and no lives are lost. Also, the same battle scenario can be tried repeatedly, using various approaches to determine the best, most effective way of doing things. By studying the results, improvements in combat skills can be made. A wargame consists of three components: the combat resolution system and two players, as shown in Figure 17 (Kabanek, 1991). The combat resolution system is part of the wargame that determines the results of the actions of the players.



**FIGURE 17. Standard wargame model showing components.**  
(Adapted from K.W. Kabanek 1991)

Thousands of commercial wargames have been developed over the last 35 years, and hundreds of these address airpower in some form (Goehring, 1993). The wargames must be chosen on the basis of what needs to be learned and practiced. The following sections describe various wargames and simulations performed by the AF and, when available, scoring criteria (MOEs/MOPs) are provided.

### **BATMAN & ROBIN**

BATMAN (Battle-Management Assessment System) is a computer-based wargame simulation developed to assess how well military personnel can allocate, deploy, and manage air, surface, and/or

subsurface tactical assets during simulated battles in many warfare areas (Kabanek, 1991). ROBIN (Raid Originator Bogie Ingress) was developed to rapidly generate Red force raids comprising large numbers of air, surface, and/or subsurface tactical assets against Blue task forces or land bases in many warfare theaters. To complete the creation of a scenario, the user specifies, in ROBIN, the Blue force tactical resources that will be available in BATMAN for allocation, deployment, and management as well as Green (neutral) force air, surface, and/or subsurface movements. Together, BATMAN & ROBIN, form a desk-top, computer-based, performance-measurement system incorporating high-resolution graphics, low-level modeling, and artificial intelligence techniques to fill the gap between board games that are run in real or fictitious time, with subjective assessment and inappropriate feedback, and very expensive and man-hour-intensive, mainframe-based simulators (Federico, Ullrich, Van de Wetering, Tomlinson, & Long, 1991).

Because of the nature of their generic software and independent databases, as well as the potential for incorporating different computer models, BATMAN & ROBIN can be used for a variety of objectives: (1) training and testing tactical knowledge, (2) planning and decision aiding for tactical situations, (3) developing and evaluating tactics themselves, (4) analyzing and evaluating various tactical sensor, weapon, and communication systems, (5) front-ending sophisticated tactical computer models and complex databases, (6) interfacing tactical artificial intelligent and expert systems, (7) generating rapidly scenarios for tactical trainers, (8) prototyping complicated scenarios for major wargaming systems, (9) orienting novices to facets of naval warfare, (10) evaluating tactical display symbologies and formats, and (11) providing an experimental environment for studying tactical decision-making. Additionally, although designed by the US Navy, BATMAN & ROBIN can be easily programmed to benefit all military branches (Federico et al., 1991).

BATMAN assesses the tactical decision-making of the individual managing the entire battle, or any of its components, in terms of composite warfare structure, by measuring performance automatically and objectively against multivariate MOEs (i.e., “number of targets hit,” “percent of threats detected/destroyed,” “time to deploy”). Performance on these MOEs immediately is fed back to the user at the end of each scenario. These measures are saved by the system for subsequent statistical analyses, and are available for evaluations of performance (Federico et al., 1991). Examples of scoring criteria (MOEs/MOPs) in BATMAN & ROBIN include “number of targets found/destroyed,” “airdrop accuracy,” “pilot workload,” and “number of misses.”

## **MARS**

The purpose of the Multi-Warfare Assessment and Research System (MARS) simulation is to provide a user-friendly, battle-force level, Monte Carlo model of multi-warfare battle engagements of Anti-Air Warfare (AAW), Anti-Submarine Warfare (ASW), Anti-Surface Warfare (ASUW), Strike Warfare (STW), Mine Warfare (MIW), and EW. The simulation is used to evaluate the effects of new or existing platforms, weapons, or system capabilities, as well as command and control concepts, in the context of multiple platform engagement level analysis. The model is capable of simulating naval engagement situations ranging from battle force level to low intensity conflict. This includes sea control, power projection, and land strike attack of enemy territory, Surface Action Group (SAG), Underway Replenishment Group (URG), and Convoy and Amphibious Landing operations. The simulation uses generic algorithms to model or calculate system performance based on user-defined characteristics and will provide similar fidelity to both offensive and defensive forces, allowing analysis of forces employed in either role (Dauer, personal communication, July 19, 1996).

MARS is summarized as follows:

- *Domain:* Land, sea, air, space, and undersea
- *Span:* Scaleable - theater, regional, local, or individual
- *Environment:* All weather, all seasons (limited databases)
- *Force Composition:* Mix forces - combine, joint

- *Scope of Conflict:* Primarily conventional warfare
- *Mission Areas:* All conventional missions

The simulation is an event-driven naval warfare simulation in a multiwarfare, multimission environment. MARS simulation provides the battle simulation functions in either a non-interactive mode or a man-in-the-loop (wargaming) mode. In the non-interactive mode, the simulation provides a single or multiple iteration capability as well as a graphical display during simulation. In this mode, MARS provides a Monte Carlo simulation using a user input decision tree. This mode will generate statistics as output for conducting studies. In the man-in-the-loop wargaming mode, human decisions are employed to try different tactics, as well as to develop operational strategy. In both modes, the simulation functions include platform kinematics, sensor detections, single and multiple platform data fusion, targeting, weapons assignment, resource allocation, cooperative engagement, launching of platforms, weapons and decoys, engagement outcome and battle damage assessment, command and control, and communications. The simulation functions also include an interactive graphics display of the battle and selected MOEs.

### **TAC BRAWLER**

The Tactical Air Combat Simulator (TAC BRAWLER) is designed to simulate air-to-air combat between multiple flights of aircraft in both visual and beyond-visual range (BVR) arenas (SURVIAC, 1994). Emphasis has been placed on simulating cooperative tactics and on capturing the importance of situation awareness in this tactical air environment. The user decides the pilot's decision process, including mission and tactical doctrines, pilot aggressiveness, perception of the enemy, reaction time, and quality of decisions made. TAC BRAWLER models the aircraft's aerodynamics, missiles, radars, communications,IRST, IFF, NCID, RWR, and missile launch warning devices. TAC BRAWLER is structured as an event-store simulation with most real-world stochastic features operating on Monte Carlo principles. Examples of MOEs/MOPs focused on in TAC BRAWLER include "number of targets killed" (Red on Blue and Blue on Red kills) and "total targets found/destroyed" (SURVIAC, 1994).

### **LCOM**

The AF Logistics Composite Model (LCOM) system is a family of programs consisting of data preparation programs, a main simulation program, and a series of post processors (Clark, 1989). The main simulation program is a Monte Carlo, discrete event simulation designed to model a wide range of weapon system activities. LCOM's main use in the AF has been in the modeling of aircraft maintenance activities, maintenance people, spare parts, and aerospace ground equipment (AGE) (Boyle, 1990). An LCOM database consists of a schedule of sortie demands, component failure rates, and a logical network of all required maintenance tasks/activities. Each task may require a unique set of resources (e.g., support equipment, spare parts, facilities, personnel) and an average time to perform (Clark, 1989). LCOM can be used to determine resource levels, as well as to assess the impact of their availability on aircraft sortie generation (Boyle, 1990). MOEs/MOPs focused on in LCOM deal with maintainability and sortie production issues.

### **Military Competitions**

AF competitions involve teams competing for top honors based on skills such as flying, loading, refueling, maintaining, directing, and guarding military aircraft. These competitions emphasize team, element, and individual competition. The team with the highest combined score from all the events is considered overall winner of the competition. The following sections discuss some competitions organized and performed by ACC and AMC and, when available, scoring criteria (MOEs/MOPs) are provided.

## **William Tell**



During ACC's William Tell competition, each pilot, weapons director, load crew, and maintenance team is given the opportunity to display individual, as well as team/element, ability in a mix of events covering four separate mission profiles and concurrently run weapons loading ("loadeo") and maintenance competitions. The purpose of William Tell is to test aircrew performance under simulated combat conditions. Teams (from the AF, AFRES, ANG, and Canadian Forces) are made up of 36 people, and are judged on the results of attacks on drone targets, as well as on air-to-air skills against a variety of simulated threats. The team that accumulates the highest composite score from all the events is the overall winner (ACC/DOOO, 1996; Correll, 1996).

Scores at William Tell are earned as a result of armament (i.e., missiles) launches (real and simulated) and timing of armament launches (real and simulated). Scoring examples (to include penalty points) include these MOEs/MOPs: "engagement times," "kills per sortie," "radar missile lock times," "missile miss distance," "late and early takeoffs," "fratricide," "serviceability," "equipment condition," "ramp condition" (e.g., cleanliness), and "spare parts on-hand" (ACC/DOOO, 1996).

During William Tell competitions there is one maintenance competition comprising three separate categories. The goal of each unit's maintenance team is the maintainability and reliability of their weapons systems. Maintenance teams are judged daily on maintenance procedures, aircraft performance, and standards compliance/serviceability (ACC/DOOO, 1996). Scoring examples include these MOEs/MOPs: "ground and air aborts," "malfunctions," "maintenance late takeoff," and "time of regeneration." Figure 18 shows pictures taken during the Maintenance Competition at William Tell '96.



**FIGURE 18. Scenes from William Tell '96 - Maintenance Competition.**  
(Source: US Air Force Photo.)

The weapons loading “Loadeo” competition consists of one evaluated static munitions load per element. Each element is authorized one three-member competition weapons load crew which will participate in the static load (ACC/DOOO, 1996). The Top Loadeo Team Award is based on the highest combined elements score. Scoring examples include safety violations, regulation violations, failure to reject, undetected foreign object, reliability, and exceeding time standards. Figure 19 shows pictures taken during the Loadeo Competition at William Tell '96.



**FIGURE 19. Scenes from William Tell '96 - Loadeo competition.**  
**[Source: US Air Force Photo.]**

### ***Gunsmoke***

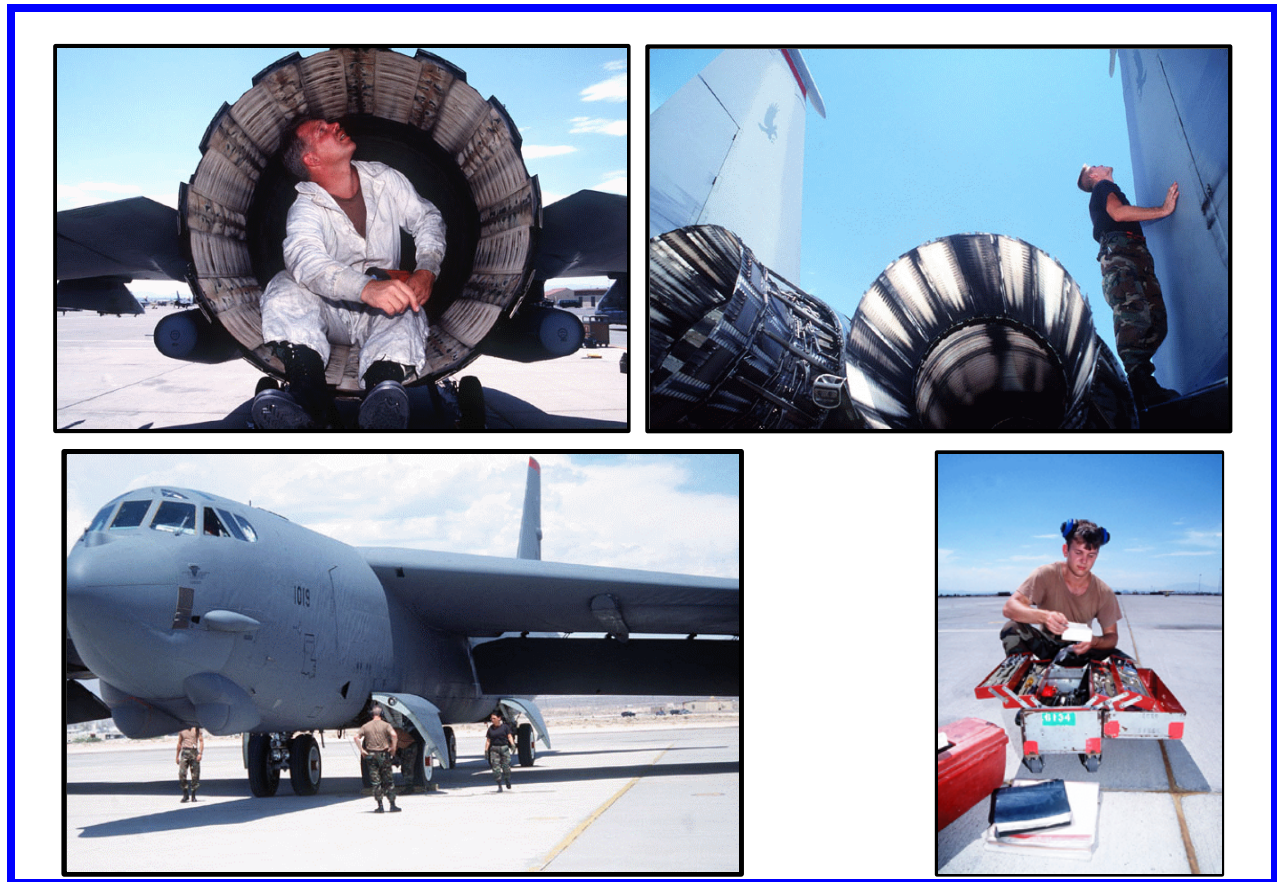
Gunsmoke is a MAJCOM composite force gunnery meet between teams sponsored by ACC, United States Air Force Europe (USAFE), Pacific Air Forces (PACAF), AETC, ANG, and AFRES (Correll, 1996; GUNSMOKE History, 1995). Emphasis is on enhancement of teamwork through composite force planning, short-notice execution, and competition. Gunsmoke is conducted as a low-cost, short-notice, come-as-you-are war, involving minimal training preparation for execution. Gunsmoke “tests the conventional air-to-surface capability of the combat air forces, recognizing the best aircrews, maintenance teams, and munitions load teams” (Correll, 1996, p.128). This is a “tactical” composite force employment competition, with emphasis on MOEs: “bombs on target,” “bombs on time,” with “no blue losses” (GUNSMOKE History, 1995).

Each composite force team is tasked to execute an Air Tasking Order (ATO) fragged (fragmentary) mission. The missions are flown against medium/high threat SAM and AAA assets and adversary air (GUNSMOKE History, 1995). Real-time kill removals are used. All Blue force missions including en route air refuel (except Bombers) and pre-strike air refuel (if required), execute their attack plan on the Nellis Range Complex, and then recover and land at Nellis AFB. All missions involve an Average Sortie Duration (ASD) of approximately 5.5 hours (GUNSMOKE History, 1995).

Scoring (including negative points) in Gunsmoke is based on “Bombs on Target” by Blue, “Time-Over-Target” (TOT), “direct hits of fragged targets,” “Red kills by Blue,” “Blue kills by Red,” “Fratricide,” and “Bombs on Target” by Red (GUNSMOKE History, 1995).

## ***Long Shot***

Long Shot is a mixed-force long-range bombing competition to test the integration of bomber and fighter aircraft that perform conventional missions (AFNS, 1996b). Sponsored by ACC, Long Shot is considered the “Super Bowl” of force projection and composite force competitions. Emphasis during this competition is on flight commander leadership and the enhancement of teamwork. Each team reacts to a short-notice tasking, plans a long-range mission into a ‘first-look’ target array, and defends against surface and airborne threats (AFNS, 1996b). The team demonstrating the ability to plan and execute with bombs on time, on target, with minimal losses, is the competition winner. Figure 20 shows pictures taken during competition at Long Shot ‘96.



**FIGURE 20. Scenes from Long Shot ‘96.  
(Source: US Air Force Photo.)**

## ***RODEO***

This is an annual competition hosted by the AMC as Transportation Command’s tanker/airlift competition. This competition tests the flight and ground skills of aircrews, as well as the related skills of combat control, security police, aerial port, aeromedical evacuation, and maintenance team members (AMC/PA, 1996; Correll, 1996). RODEO features competitions in two events; Flying and Non-flying.

***Flying Competition.*** RODEO’s flying events consist of six different competitions: (1) aerial refueling, (2) aircraft navigation, (3) single integrated operations plan, (4) airdrops, (5) shortfield landings, and (6) cargo landing.

Each event is scored based on a predetermined set of MOEs/MOPs. Some MOEs/MOPs used in the flying events include “airdrop accuracy,” and “alert times.” Other measures include timing & accuracy in navigating to air refueling point, ability to land on short airfields, and navigation skills tested during aerial refueling mission using no more than three radar fixes (AMC/PA, 1996). Figure 21 shows pictures taken during the flying competition at RODEO ‘96.



**FIGURE 21. Scenes from RODEO ‘96 - Flying Competition.**  
(Source: US Air Force Photo.)

*Non-Flying Competitions.* RODEO’s non-flying events consist of five different competitions:

- (1) combat control
- (2) aerial port
- (3) maintenance
- (4) security police
- (5) aeromedical evacuation.

For the purposes of this report, the maintenance event is used as an example. In this event, the goal is to evaluate maintainers’ ability to keep command aircraft ready to meet operational commitments. The MOEs/MOPs used to assess this event pertain to “maintenance/maintainability” measures (e.g., “mean time to repair,” “fix rate,” “mean down time,” “maintenance turn time”). Other surrogate measures include combat and technical skills acquired through day-to-day duties and unit training (AMC/PA, 1996). Figure 22 shows pictures taken during the various non-flying competitions at RODEO ‘96.



**FIGURE 22. Scenes from RODEO '96 - Non-Flying Competitions.**  
(Source: US Air Force Photo.)

## Tests and Evaluations

The AF needs to ensure that the weapons systems being developed and fielded, and the systems that support them, meet or exceed operational requirements in terms of effectiveness and suitability, and are ready for fielding. The Air Force Flight Test Center (AFFTC) plans, accomplishes, and reports on AF development test and evaluation (T&E) of manned and unmanned aircraft systems; supports and participates in AF initial operational test and evaluation (OT&E) and follow-on tests for manned aircraft systems; operates the USAF Test Pilot School; and controls and operates test facilities used to support flight testing. The AF and AFFTC conduct realistic, cost-effective, and credible T&E programs through all phases of the acquisition and fielding process (AFI 99-102, 1994; AFD 99-1, 1993).

AFOTEC plans and conducts OT&E (AFMD 14, 1996). The primary purpose of an OT&E is to determine the operational effectiveness and suitability of AF systems, and the capability of the system to meet mission needs (AFI 99-102, 1994; AFMD 14, 1996). Testers conduct OT&E in as realistic an operational environment as possible to determine if a system meets the warfighters' requirements and supports mission accomplishment. These realistic conditions should be representative of both combat stress and peacetime operational conditions. Testers use modeling and simulation (M&S) as an evaluation tool to augment, extend, or enhance field test results (AFI 99-102, 1994). Further, the users and testers select MOEs, MOPs, and system characteristics to evaluate whether the system meets stated requirements. MOEs and MOPs originate from the user-developed Cost and Operational Effectiveness Analysis (COEA), and provide the basis for testing system military worth (AFI 99-103, 1994).

Three basic types of OT&E are conducted by AFOTEC: Initial (IOT&E), Qualification (QOT&E), and Follow-on (FOT&E) (AFI 99-102, 1994; 1995; AFD 99-1, 1993). Under as operationally realistic conditions as possible and practical, these three types of OT&E demonstrate that systems under test are operationally effective, suitable, and capable of meeting the warfighters' requirements. IOT&E and QOT&E results support the decision to proceed beyond low-rate initial production or to field the system (AFD 99-1, 1993). FOT&E supports decisions relative to the service life of the system (AFD 99-1, 1993). Table 8 discusses each type of OT&E in relation to its application (AFOTEC 99-101, 1995).

**TABLE 8. Test-Type Application Matrix**

OT&E TYPE	WHEN TO USE	USED FOR
<b>IOT&amp;E</b>	<ul style="list-style-type: none"> <li>• to support beyond low rate initial production (LRIP) (Mile Stone [MS] III)</li> <li>• when 3600 (R&amp;D) money is used</li> </ul>	<ul style="list-style-type: none"> <li>• determining operational effectiveness and suitability</li> <li>• supporting fielding/initial operational capability (IOC) decision</li> <li>• assisting in tactics development</li> </ul>
<b>QOT&amp;E</b>	<ul style="list-style-type: none"> <li>• non-developmental items (commercial off-the-shelf/nondevelopmental item), or modifications to existing systems</li> <li>• when 3400 (operations and maintenance [O&amp;M]) money is used</li> </ul>	<ul style="list-style-type: none"> <li>• (same as IOT&amp;E)</li> </ul>
<b>FOT&amp;E</b>	<ul style="list-style-type: none"> <li>• after MS III</li> </ul>	<ul style="list-style-type: none"> <li>• ensuring the system continues to meet user requirements</li> <li>• tactics development</li> </ul>

An OT&E MOE is defined as a measure of a system's mission task accomplishment. According to AFOTEC (AFI 99-102 1994; AFOTECI 99-101, 1995), an OT&E MOE should be developed to a level of specificity so that a system's effectiveness can be evaluated with the effectiveness criteria consistent with the COEA. OT&E MOEs are quantitatively linked to COEA MOEs when sensible. When the COEA MOEs are not available or do not account for all operational task accomplishments, AFOTEC and the user will coordinate to develop testable OT&E MOEs to evaluate operational effectiveness and suitability (AFI 99-102 1994; AFOTECI 99-101, 1995). Developing MOPs enables the AFOTEC test team to define all the test outcomes (data) that must be gathered and then summed to completely evaluate a system. Examples of MOEs and MOPs can be found in AFOTEC 99-101, *Test Concept Handbook* (AFOTEC/XRC, 1995) as well as in Appendix B of this study.

Each OT&E requires the development of MOEs and MOPs tailored to its specific requirements. Although the following list of questions is not exhaustive, it includes key elements of concern to the OT&E structure (AFI 99-102 1994; AFOTECI 99-101, 1995; AFI 99-103, 1994).

- (1) Are the MOEs related to Critical Operational Issues (COI)? (A COI is a key operational effectiveness or suitability issue that must be examined in OT&E to determine the system's capability to perform its mission. A COI is normally phrased as a question to be answered in evaluating a system's operational effectiveness and/or suitability.)
- (2) Are the MOPs linked to the MOEs? To COIs? (In some cases, MOPs designed to measure specific performance requirements in the ORD may not be directly linked to MOEs/COIs.)
- (3) Are MOEs/MOPs quantitative (where practicable)?
- (4) Do the MOEs/MOPs address the requirements?
- (5) Are MOEs/MOPs feasible/executable in terms of time, cost, and resources?
- (6) Which MOEs/MOPs can be satisfied by field testing, and which must be addressed by simulation or combination?
- (7) Do MOEs/MOPs call for evaluation of maintenance and other logistics requirements?
- (8) Are there unique support aspects related to the system that should be integrated into MOEs/MOPs?
- (9) Are support issues such as human factors, safety training, integrated diagnostics, and software maturity sufficiently addressed?
- (10) Are the methods of determining the impacts of support issues on system effectiveness or suitability described?
- (11) Are modeling and simulation addressed?
- (12) Are system survivability (susceptibility/vulnerability) requirements addressed?
- (13) If an acquisition program has a COEA, are testable MOEs quantitatively linked to the COEA?
- (14) Have the MOEs/MOPs been discussed with AFOTEC during the informal strategy session?

After the MOEs/MOPs have been identified, a test method must be devised with specific data requirements to answer each MOE/ MOP. Field testing is the primary arena to operationally evaluate system effectiveness and suitability (AFOTECI 99-101, 1995; AFI 99-103, 1994). Field testing can be supplemented by modeling, simulation, studies, etc. Each OT&E should be developed to accomplish *mission level evaluation*, not necessarily *mission level testing* (AFOTECI 99-101, 1995). (Examples of this type of testing are the “-ilities” testing. Testing of a system’s “*turn-around time*” reflects the system’s generation capability. The turn-around time is a mission level test; the generation capability is a mission level evaluation.) Tests must be at the appropriate level for the system or subsystem being evaluated. Whether evaluating MOPs in support of MOEs or in support of ORD performance requirements, the focus should be on *performance* within the context of the system’s mission, rather than on system *specifications* (AFOTECI 99-101, 1995). The rating of an MOE/MOP reflects the demonstrated performance as compared to evaluation criteria (refer to Figure 23). MOEs/MOPs with evaluation criteria are rated as follows:

- **“Met User Criteria”** describes performance that met or exceeded a stated OT&E criterion or the stated aggregation outcome.
- **“Did Not Meet User Criteria”** describes performance that did not meet an OT&E criterion or the stated aggregation outcome.
- If performance was not tested, the results must be labeled as **“Not Tested.”**

MOEs/MOPs, which do not have evaluation criteria, are not rated. Results are reported in narrative format (e.g., average completion time, distribution of questionnaire ratings, or other summary statistics) (AFOTECI 99-101, 1995). COIs will be rated two ways (see Figure 23):

- Based on the adequacy of test data collected, each COI will be reported as **“Resolved”** or **“Not Resolved.”**
- Based on the performance exhibited by the collected data, each resolved COI will be reported as **“Satisfactory”** or **“Unsatisfactory.”**

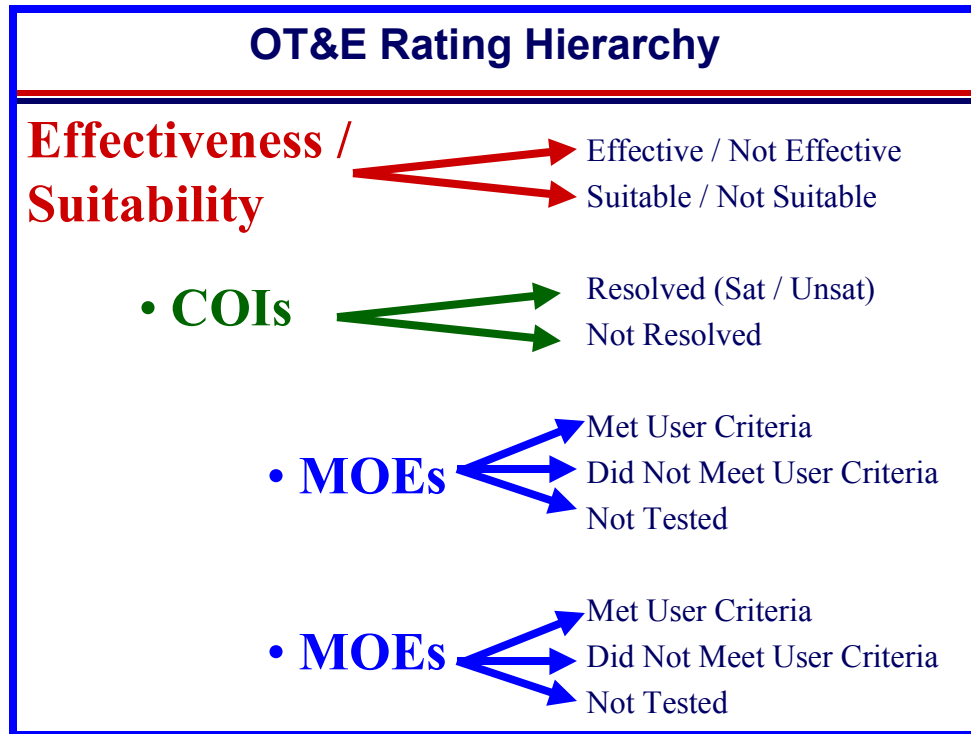
Effectiveness and suitability will be rated as follows, and conclusions will be based as much as possible on quantitative test data but may involve test team judgment (see Figure 17):

- Effectiveness will be rated as **“Effective”** or **“Not Effective.”**
- Suitability will be rated as **“Suitable”** or **“Not Suitable.”**

### ***Operational Readiness Inspection (ORI) Criteria***

AF commanders must continuously evaluate force readiness, and organizational efficiency and effectiveness. The inspection system provides the commander with a credible, independent assessment process to measure capability of assigned forces (AFPD 90-2, 1996; AFI 90-201, 1997). Thus, Operational Readiness Inspection (ORI) results can be contrasted with SORTS ratings that are controlled by individual unit commanders to ensure higher level commanders have an independent assessment of unit performance periodically made by the IG. The AF Inspection System promotes a culture that encourages and recognizes continuous improvement. Inspectors benchmark best practices, lessons learned, and innovative methods in accomplishing the AF mission. When commanders become aware of a deficiency, they are likely to invest budget and effort in improving the situation. AF IGs AF perform the following:

- Assess the readiness, discipline, efficiency, and economy of the AF, and report findings to the Chief of Staff of the AF and the SAF.
- Establish common-core evaluation criteria
- Approve AF-wide special interest items.



**FIGURE 23. OT&E Rating Hierarchy.**  
(Adapted from AFOTECI 99-101, 1995)

An ORI has been defined as an inspection that evaluates all units with a wartime mission on their operational readiness or their ability to conduct combat operations in wartime (AFPD 90-2, 1996; AFI 90-201, 1997). The MAJCOM evaluates subordinate units on how well they can respond, employ forces, provide mission support, and survive and operate in a combat environment. To do this, MAJCOM commanders:

- Establish ORI criteria, which include four major grading areas: Initial Response, Employment, Mission Support, and Ability to Survive and Operate.
- Conduct ORIs of assigned active and gained AFRES and ANG combat, combat support, and combat sustaining units. Numbered Air Force (NAF) activities may be tasked to conduct ORIs of gained AFRES and ANG units.
- Conduct Quality Air Force Assessments (QAFA) of NAFs, their subordinate active duty units, and gained ANG units. QAFAs will evaluate results as well as processes.
- Conduct Contract Support Activity Inspections to determine if contractors are meeting contractually defined mission requirements and to provide commanders an independent assessment of operations and maintenance contracted activities.
- Conduct Nuclear Surety Inspections of assigned units as required by the Directorate of Nuclear Surety.

The *Initial Response* section of an ORI is an evaluation of the unit's capability to transition from peacetime to contingency operations or wartime posture, and includes all actions which normally occur prior to the outbreak of hostilities (SAF/IG, 1996a; AFI 90-201/ACC SUP 1, 1996). This section describes procedures and criteria common throughout the ACC. For instance, as regards "Aircraft Criteria," the aircraft maintenance support function is evaluated on its ability to manage and control assigned resources, content and use of plans, technical data compliance, aircraft combat capability, and safety. Attachment 2 of this study (located at the end of this report) contains ORI information for AMC and AFSOC, as well as a consolidated ACC list (AFI 90-201/ACC SUP 1, 1996; AFI 90-201/AFSOC SUP 1, 1995; AMCI 90-201, 1996; SAF/IG, 1996a).

In the ACC's ORI for aircraft deployment, the IG rates the unit based on measures including number of aircraft successfully deployed, organization and content of deployment briefing, particular aspects of the actual mission (e.g., flight discipline and mission conduct), number of aircraft arriving at the employment base, and quality of maintenance support (AFI 90-201/ACC SUP 1, 1996). For the area of regeneration after deployment, the inspection evaluates the deployed unit's ability to attain a combat-ready posture for the in-theater commander as soon as possible after arriving at a deployment base. Timing, number of aircraft successfully regenerated, and quality of maintenance support determine the overall rating (AFI 90-201/ACC SUP 1, 1996).

The *Employment* section of an ORI is an evaluation of a unit's ability to support and employ combat forces, provide aerial/ground control of air battle, and provide continuous communications capability during contingencies or wartime (AFI 90-201/ACC SUP 1, 1996). The three primary sub-areas of employment evaluated are *Command and Control*, *Maintenance*, and *Operations*. For this research, emphasis will be placed on Maintenance.

Maintenance is evaluated on the accuracy, timeliness, and adequacy of actions to receive, interpret, and disseminate tasking information from the wing operations center/command and control elements to flight-line/work area supervisors (AFI 90-201/ACC SUP 1, 1996). Additionally, the aircraft maintenance function is evaluated on management practices used to produce quality maintenance in support of the unit's contingency tasking. Both the primary and alternate Maintenance Operation Center (MOC) are evaluated, including their ability to efficiently relocate as required by the exercise scenario. The effectiveness of the unit's combat sortie generation plan is also assessed. In general, the following are evaluated and considered in determining the unit's overall rating: direction and coordination of maintenance actions (include the assignment and control of personnel), cooperation between the maintenance units and agencies, information flow from the flightline to MOC, and supervisory involvement and decision-making. The proper use of technical data, safety protection gear, and test equipment; accuracy of aircraft forms documentation; prioritization of shop tasks; repair of aircraft components; radio discipline; foreign object damage awareness; and, if used, hot refueling procedures are also considered (AFI 90-201/ACC SUP 1, 1996).

### **Command Briefings**

Another source of valuable information comes from command briefings sometimes called "Health of the Force" (HOF) Briefings. Each MAJCOM conducts daily/weekly/monthly meetings with the appropriate commanders and key staff to discuss the condition of their units and airplanes. For example, AMC/LGQ provided CSERIAC-UDRI with HOF briefings (also available on the world wide web at <http://amclq3.safb.af.mil/AMC/LGQ/>) for the Maintenance Management and Training Division. These briefings include MOE/MOP information on AMC's major aircraft system: C-5, C-17, C-141, KC-10, KC-135, and Transportation aircraft (listed in Appendix B). Although slightly different for each aircraft, these briefings graphically depict how well the MAJCOM meets the expected MOEs, related to a given standard set by the AMC (AMC/LGQP, 1996).

### ***MIL-STD 1776A, Aircrew Station and Passenger Accommodations***

The most extensive source of aircraft-related MOEs/MOPs was MIL-STD 1776A, Aircrew Station and Passenger Accommodations (MIL-STD-1776A, 1994). It contains a table of aeronautical MOEs/MOPs together with air tasks and subtasks, although it is not so comprehensive as to include all missions, tasks, subtasks, and formulas to compute the MOEs/MOPs. We identified no other current MIL-STD that contained MOEs/MOPs to this extent.

### ***AFI 10-602, Determining Logistics Support and Readiness Requirements***

The most comprehensive listing of aircraft maintenance-related MOEs/MOPs was found in Air Force Instruction (AFI) 10-602, Determining Logistics Support and Readiness Requirements, (AFI 10-602, 1994). This listing provides formulas to compute MOEs/MOPs like “maintenance hours per flying hours,” “mean time between failure,” and “mean time to repair,” which are the measures used to judge success at the AF wing organizational maintenance units. These measures are also used for evaluation purposes up the chain of command and for the evaluation of proposed acquisitions and modifications.

### ***Unit Quality Maintenance Metrics***

Organizations performing aircraft maintenance must continually assess their performance, aiming to improve results for two major customers-the operators and the aircraft. This dual obligation of aircraft maintenance leads to a balancing act where maintainers are challenged to meet operator requirements and still maintain equipment to the highest technical standards. To meet this challenge, the AF defines “Quality Maintenance” as “Meeting or exceeding aerospace equipment technical specifications and a customer’s requirements through the effective integration of management; people; technical data; workplace; and equipment, supplies, and services” (AFI 21-101, 1996, p. 19). Quality Maintenance is assessed through Quality Assurance (QA) programs set up by the AF and sponsoring MAJCOM unit. The QA process ensures the proper collection and presentation of performance measures, facilitates process improvement efforts, investigates problems, and communicates with agencies outside the unit on technical maintenance matters (AFI 21-101, 1996).

According to AFI 21-101, *Maintenance Management of Aircraft* (AFI 21-101, 1996), the AF considers the following objectives as gauges for determining maintenance performance: Timely delivery of reliable, mission-ready aerospace equipment; Safe people, equipment, and procedures; A competent workforce that is effective, accountable, and responsive; Adherence to prescribed directives; Accurate reporting and documentation; and Responsible and efficient use of available resources.

Measuring performance against these objectives provides any aircraft maintenance activity insight on where it needs to improve. AFI 21-101, Attachment 5, *Operational Definitions for Quality Maintenance Metrics*, provides the AF with operational definitions for eight metrics which units *must* use to assess their performance (AFI 21-101, 1996)<sup>3</sup>. These metrics are Code 3 Status Breaks, Maintenance Related On-duty Ground Mishaps, Qualified Personnel, Aircraft Forms Status, Scheduling Effectiveness, Maintenance-related Inflight Emergencies, Aircraft Mission Supportability, and Adherence to Directives. These are the highest priority metrics for reporting and tracking at the Air Staff Installations and Logistics (AL/IL) areas of concern. Tracking performance against these metrics provides feedback whereby each objective is addressed and ultimately improved. Reviewing processes will help target areas requiring improvement. Improving those areas will drive each metric in the desired direction, thereby improving maintenance quality (AFI 21-101, 1996).

---

<sup>3</sup> A full description of these metrics can be found in the Taxonomy in Appendix B of this report. They can be identified by the footnotes attached.

## ***MAAs & MAPs***

A third source of high-level MOEs/MOPs is the Defense Modernization Planning process (USAF/XOXP, 1996). In this structured process, Mission Area Assessments (MAAs) are being developed for each mission area. The products of these assessments are documented in Mission Area Plans (MAPs) which include both MOEs/MOPs and deficiencies (Air Mobility Command [AMC]/Plans [XP], 1995). Also by implication, one can develop additional MOEs/MOPs from these deficiencies.

## ***Acquisition Documents***

Related to the MAAs and MAPs are the Mission Need Statements (MNSs) and Operational Requirements Documents (ORDs) which contain MOEs/MOPs for new or modified acquisitions. In an ORD, the Requirements Correlation Matrix (RCM) table contains detailed MOEs/MOPs that are requested by the using MAJCOM for the new or modified system.

## ***Readiness Reporting Systems***

AF Policy Directive (AFPD) 10-2, Readiness (AFPD 10-2, 1997), requires that commanders assess the readiness of their resources. The prime readiness reporting system is the Status of Resources and Training System (SORTS). SORTS is the mechanism for assessing the readiness or "C-Rating" of each operational unit and reporting it up the chain of command. SORTS concentrates on four areas of determination: (1) personnel, (2) equipment on hand, (3) training, and (4) equipment condition. The AF version of SORTS is called the AF Integrated Readiness Measurement System (AFIRMS) (AFI 10-201, 1995; SofTech, 1985). Other forms of readiness data and reporting systems have been developed or tested to supplement SORTS because it was considered by the General Accounting Office (1996) to be inadequate. These other systems include the following: the Joint Readiness Management System (Gillis, 1996), Joint Automated Readiness System (JARS) (Neal, 1996), and the Readiness Baseline Indicators project (Medlock, 1996). Each of these R&D systems offers a different emphasis, including the ability to assess the readiness to perform specific missions and the tasks associated with those missions. These readiness and reporting systems emphasize the importance of relating MOEs/MOPs to the mission.

## ***Joint Mission Essential Task Lists (JMETL)***

The Joint Staff is implementing a process by which joint force commanders analyze their missions and establish mission requirements in the form of JMETL (Wagner, 1996). A JMETL task includes the conditions under which the task is to be performed, to the standard to which the task is to be performed, as well as a standard task listing. The JMETL is implemented under Chairman of the Joint Chiefs of Staff Manual (CJCSM) 3500.04A, (CJCSM 3500.04A, Section 3, 1996). The JMETL was developed because current readiness assessment is based on generic predictions of a unit to perform its primary missions and these assessments have not been mission-sensitive. To make mission-based assessments, task-based performance data is required. When implemented and when historical data is collected, this system will allow for higher fidelity estimates of US capabilities to perform specific missions. The JMETL is to assist with joint training plans and exercises, as well. Each service is tailoring a version of the JMETL, such as the Universal Navy Joint Task List (Kennard, 1996, & Universal Naval Task List [OPNAVINST 3500.38], 1996). CSERIAC-UDRI provided the draft Aeronautical MOE/MOP Taxonomy listings to the Joint JMETL Office, and the Navy, and Air Force mission task offices for inclusion in their mission essential task listing documents.

## ***AF Aircrew Evaluation Criteria Instructions***

A series of Air Force Instructions (AFIs) (11-2a and f) covering Aircrew Evaluation Criteria were reviewed to determine the support for existing MOE/MOPs, and to add additional appropriate ones. (See Section 9 for a full explanation of the development of the aircrew evaluation criteria taxonomy and the specific AFIs and aircraft used.)

### Surrogate Measures

Because competitions and exercises cannot always use warfighting MOEs and MOPs, AF managers usually develop surrogate measures. Commanders accept the surrogate measures as strong indications that if a war did erupt, the AF would perform similar to that indicated by the surrogate measures. These surrogate measures might be helpful to target as proof of demonstrated warfighting capability. If an MPT technology can improve performance on these surrogate measures, it may be easier to establish credibility with commanders and senior managers who make budget decisions and support research. Some examples of surrogate measures include days to complete task, territory lost/gained, average range detected/destroyed, cleanliness, late/early takeoffs, and navigation skills. Table 9 (taken from Appendix C) lists examples of surrogate measures found in various exercises and competitions.

**TABLE 9. Sample Surrogate Measures**

Exercise/Competition	Surrogate Measure
William Tell (ACC/DOOO, 1996)	<ul style="list-style-type: none"><li>• Equipment condition</li><li>• Ramp condition (cleanliness)</li><li>• Late &amp; early takeoffs</li><li>• Spare parts on-hand</li></ul>
Nimble Dancer (GAO/NSIAD-96-170, 1996)	<ul style="list-style-type: none"><li>• Level of Risk</li><li>• Forward Line of Troops</li><li>• Days to Complete Battle</li><li>• Buildup</li><li>• Counterattack</li><li>• Territory Lost/Gained</li></ul>
GUNSMOKE (GUNSMOKE History, 1995)	<ul style="list-style-type: none"><li>• Direct hits of fragged targets</li></ul>

### Sample MOEs/MOPs

To be useful, both MOEs and MOPs must be measurable and realistic; e.g., measures of speed, range, and climb rate are MOPs for an aircraft. MOEs are typically measured in terms of “Sorties per Day,” “Number of Kills per Sortie,” etc. (Eisenhardt et al., 1985; MIL-STD-1776A). “Aircraft Turn-Around Time” or “Maintenance Man Hours per Flying Hour” are two examples of MOPs that can be consolidated to address the MOE of “Sortie Generation Rate.”

The list of MOEs/MOPs presented in Appendix B (see Table 10 for an excerpt of Appendix B) and the sample breakdown in Figure 24 show the interrelated nature of the categories of logistics applications. For example, “Mean Time to Repair” could be considered *Reliability and Maintainability* (R&M) MOE as well as *Maintenance* MOE. Additionally, as mentioned earlier, “Sortie Generation Rate” can be a top-level MOE or an MOP for a different MOE such as “Availability and Sustainability” (see Figure 24).

Logistical MOEs typically reflect some measure of performance about a category of logistics, but do not express a measure of support for combat troops (Battilega & Grange, 1984). Battilega & Grange explain that “fill rate” is a widely used measure of supply system effectiveness but indicates nothing about the availability of weapons systems. They also note problems of measurement, particularly with respect to measurements of time. For example, in some systems, “Time Awaiting Parts” is counted against “Repair Time.” This misnomer is actually a function of data-capture and computer software, which causes an increase of repair times and an underestimation of repair capability (Battilega & Grange, 1984). If waiting for parts or repairs prevents an aircraft from being operationally capable, regardless of the reason, the mission is likely to be degraded.

**TABLE 10. Sample Mission Effectiveness MOEs/MOPs.**

MOE/MOP	DEFINITION	REFERENCE
<b>System Performance</b>		
<b>System Capability Rate</b> (usually an MOP)	Measures a system's capability to perform. Computes the % of time a system is fully operable.	AMC/LGQA, 1995, p. 18
<b>System Reliability Rate</b> (usually an MOP)	Measure systems reliability to perform. Computes % of time a system is fully operable & partially operable.	AMC/LGQA, 1995, p. 18
<b>Turn Around Time</b> (usually an MOP)	The time required to prepare a returning mission-capable aircraft for another sortie.	AFI 21-101, 1994, p. 10; MIL-STD-1776A, 1994, p. 54
<b>Mission Preparation Time</b> (usually an MOP)	The time required to prepare a mission-capable aircraft for a sortie.	JAST, 1995
<b>Sortie Generation Rate</b> (usually an MOE)	Average # of sorties produced per aircraft during a defined period.	AFI 21-101, 1994, p. 11; AFI 90-201, 1996; AMCI 90-201, 1996; Cooper, 1996; JAST, 1995; MIL-STD-1776A, 1994, p. 54
<b>Aircraft System Operation, Maintenance/Supportability</b>		
<b>Availability</b> (usually an MOE)	The probability that a system is operable & ready to perform its intended mission at any given time.	AFI 10-602, 1994, p. 7; AFOTEC/XRC, 1994, p. D-53; 1996; JAST, 1995; MIL-STD-1776A, 1994, p. 54
<b>Sustainability</b> (usually an MOE)	A system's ability to maintain the necessary level & duration of operations to achieve military objectives. Often measured in # of days.	AFI 10-602, 1994, p. 12; SofTech, 1985, p. 2-2
<b>Mission-Capable (MC) Rate</b> (usually an MOE)	% of aircraft possessed hours that were FMC & PMC for a unit over a specified period.	AFI 10-602, 1994, pg. 10; AFOTEC/XRX, 1996; JAST, 1995; AMC/LGQP, 1996; AMC/LGQA, 1995, p. 16
<b>Maintainability/Maintenance</b> (usually an MOE)	The ability of an item to be retained in, or restored to, a specified condition within a given time period when maintenance is performed by personnel having specified skills using prescribed procedures & resources at each prescribed level of maintenance & repair.	AFI 10-602, 1994, p. 9; AFSOC/IG, 1995; AFOTEC/XRC, 1994, p. D-53; 1996; AMCI 90-201, 1996; JAST, 1995; MIL-STD-1776A, 1994, p. 54
<b>Mean repair time (MRT)</b> (usually an MOP)	The average corrective maintenance time required to return a system or part to operational status.	AFI 10-602, 1994, p. 31; AFOTEC/XRC, 1991, p. II-7; 1994, pg. D-53; 1996; Battilega & Grange, 1984, p. 54; Cooper, 1996
<b>Maintenance Man-Hours per Flying Hour (MMH/FH) support</b> (usually an MOP)	Direct maintenance man-hours required to support a system.	AFI 10-602, 1994, p. 23; AFOTEC/XRX, 1996

## 7. Aircraft Maintenance MOE/MOP Taxonomy

This section presents aircraft maintenance MOEs/MOPs and the taxonomy used to organize them, and other views of aircraft maintenance MOEs/MOPs. The majority of this section provides the rationale for organizing the aircraft maintenance hierarchy and presenting the hierarchical relationships in a series of figures.

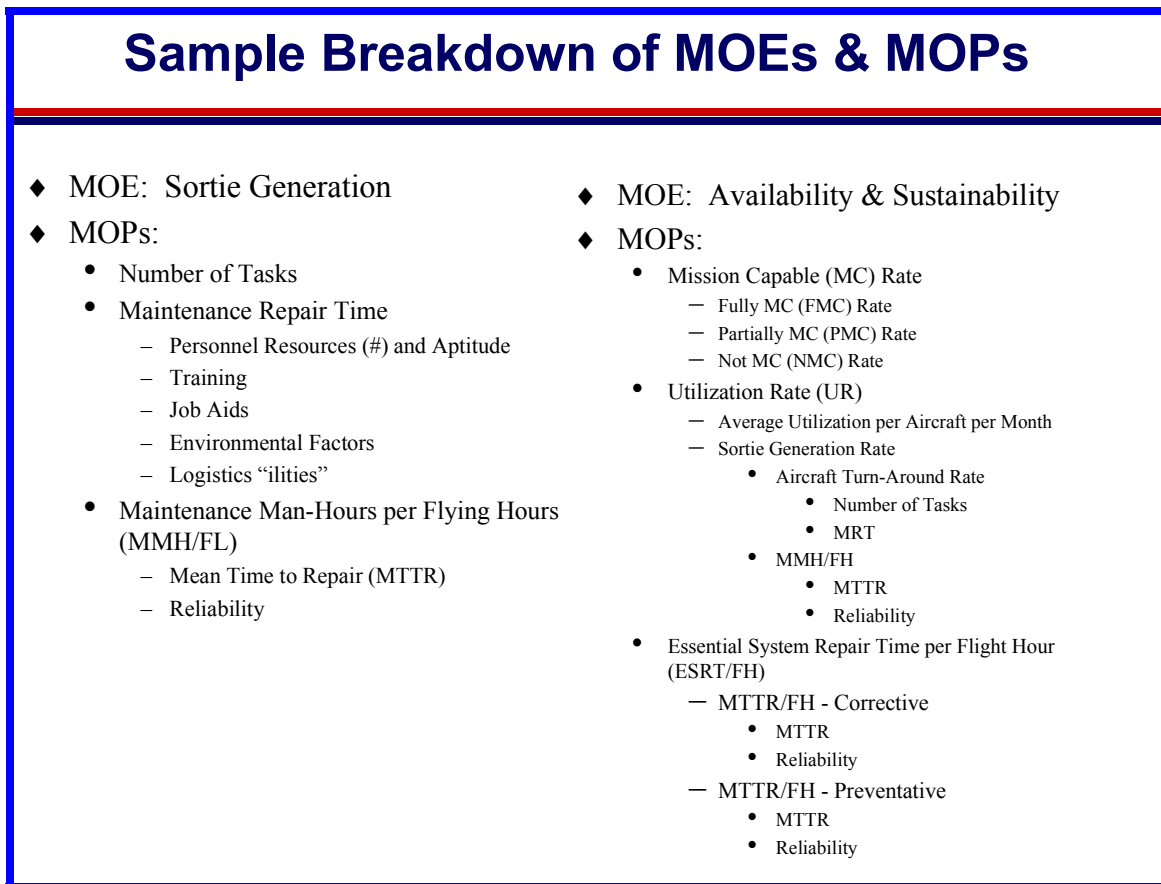
### Organization of Maintenance MOEs/MOPs

The MOEs/MOPs identified through the process documented above have been organized into the Aircraft Maintenance MOE/MOP Taxonomy, grouped under the following areas:

- System – Maintenance Performance
- Repair Times and Rates
- Turn Time
- Break and Abort Rates, and Delivery Reliability
- Maintenance Manpower

- Operational Readiness, Availability, and Mission Capable Rates
- Supply and Inventory Analysis
- Maintenance Safety
- Personnel Skill and Training Effectiveness
- System Performance and Utilization Rates

This comprehensive listing of Aircraft Maintenance MOEs/MOPs is presented in Appendix B.



**FIGURE 24. Sample Breakdown of MOEs/MOPs.**

### ***Other Views of Aircraft Maintenance MOEs***

In addition to the general listing of aircraft maintenance MOEs/MOPs, this report also presents other methods of organizing these MOEs/MOPs. Appendix C presents a list of aircraft system maintenance/supportability MOEs/MOPs that MAJCOMs must consider when describing top-level logistics requirements for aircraft systems (adapted from AFI 10-602, 1994). Additionally, Appendix D presents a comparison matrix of MAJCOM and Air Staff maintenance-related metrics. These metrics, obtained from ‘health of the force’ briefings, are considered most important to commanders and top decision-makers throughout ACC, AETC, AFSOC, AMC, ANG, PACAF, USAFE, the Air Staff, and from the Sustainment Executive Management Report (SEMR). These metrics are listed in alphabetical order. SORTS criteria are presented in Appendix E, and sources for Maintenance MOEs are presented in Appendix F.

### ***Hierarchical View of MOEs/MOPs***

Because the literature search and personal contacts failed to locate a comprehensive hierarchy of MOEs/MOPs, and due to the complex nature of visualizing the MOEs/MOPs in some logical sequence, CSERIAC-UDRI created a hierarchy of the measures relating to aircraft maintenance. The hierarchy, as seen in Figure 25, has many facets and interrelationships. It could be arranged in any number of possible ways. The format shown is that chosen by the CSERIAC-UDRI authors, with the rationale for its organization being presented below in Rules for Hierarchy Representation subsection. It is important to note that units, squadrons, or wings do not use all of these MOEs/MOPs to assess their specific readiness. Some MOEs/MOPs are more appropriate to different organizational levels, MAJCOMs, or missions. The subsequent sub-hierarchies (Figures 26-31) show, in more detail, the relation between the numerous MOEs and MOPs involved in evaluating maintenance actions. For these detailed hierarchies, when possible, mathematical equations are provided to aid in forming a true relationship between the measures. Because such hierarchical diagrams were not discovered during the extensive literature search, and because we believe this set of hierarchies are unique and useful, UDRI has, therefore, placed a “Governmental Use Copyright” on Figures 25-31 of this report.<sup>4</sup> The following paragraphs briefly describe the reasoning for the chosen layouts.

***Rules for Hierarchy Representation.*** In preparing the maintenance hierarchy, all attempts were made to include mathematical formulas at each level. To make the mathematical relationships clear, the boxes (levels) were placed in a mathematical sequence. Formulas included in other formulas feed those more inclusive formulas. When a definite mathematical formula was not available, relationships were formed based on definitions of the MOEs/MOPs involved. To depict this relationship in the maintenance hierarchy, dashed lines connect those MOEs/MOPs where exact formulas were not available or where there is no direct relationship. Solid lines connect the levels with clear mathematical or definitional relationships.

When items did not directly feed into an item above (e.g., not mainstream), the boxes were set off to the side and connected with dashed lines. If input items (lower-level boxes) were not summed in the preceding box (upper-level box), they were fed in independently, with solid lines. When two MOEs/MOPs were determined to be on approximately the same level (by definition and/or mathematical formula), they were placed side-by-side with an “approximately equal” ( $\cong$ ) sign separating them.

To provide an overall awareness of how the set of sub-hierarchies fit into the overall hierarchy, the top of each sub-hierarchy shows how it joins the next highest level of the diagram (e.g., where Sub-hierarchy B joins Hierarchy A). Where applicable, cross-references were made when multiple hierarchies used the same MOE/MOP.

***Utilization Rate/Sortie Generation Rate – Overview Hierarchy.*** Figure 25 represents the major MOEs and MOPs necessary to evaluate Utilization Rate/Sortie Generation Rate (UTE Rate). This figure serves as an overview of the relationship of five distinct areas within UTE Rate: (A) UTE Rate, (B) Adjusted Sortie Schedule, (C) Mission Capable (MC) Rate, (D) Not Mission Capable (NMC) Rate, (E) Break Rate, and (F) Mean Down Time. This layout was chosen by the authors to show a “top-down” flow, moving from high-level MOEs to lower-level MOEs/MOPs. As mentioned earlier, this layout is one of several possible arrangements, as most of these maintenance MOEs and MOPs are related.

***Utilization Rate/Sortie Generation Rate Hierarchy.*** Figure 26 shows, in detail, the MOEs and MOPs included in evaluating UTE Rate. According to the authors, UTE Rate (to include the similar measure of Sortie Generation Rate) is influenced by measures such as Total Flyable Rate (and the similar measure of Adjusted Sortie Rate, Figures 27 and 28), Combat Rate (influenced by Total Abort Rate), Repeat /Recur Rate (influenced by Cannot Duplicate), and Break Rate (Figure 30). Note that some

---

<sup>4</sup>Copyright 1996©: The University of Dayton. All commercial rights reserved. This material may be reproduced by or for the U. S. Government pursuant to the copyright license under the clause at 52.227-7013 (October 1988).

mathematical equations are provided to show the path from high-level to low-level measures. Where appropriate, references to other hierarchies are listed.

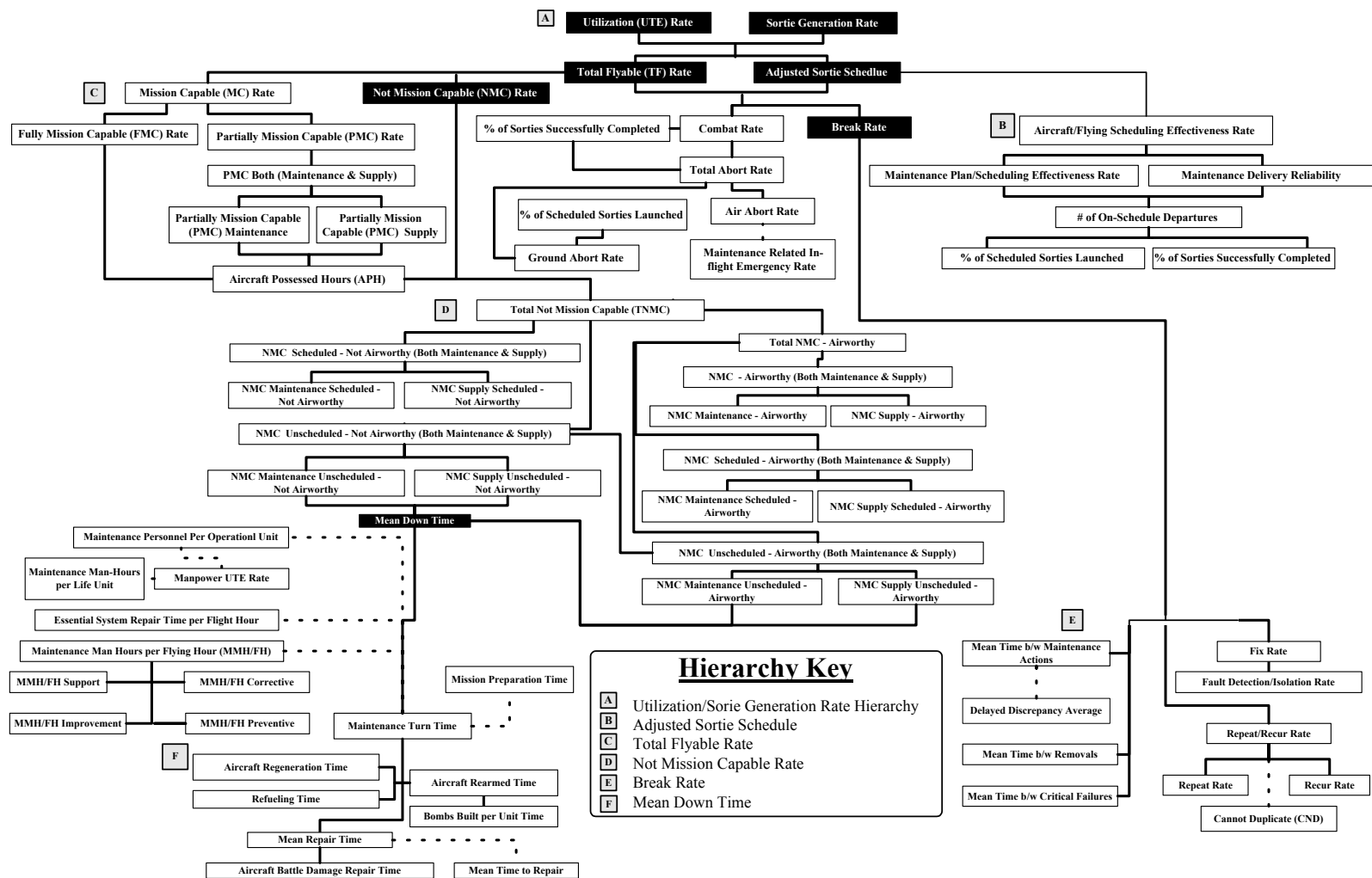
***Adjusted Sortie Schedule Hierarchy.*** Figure 27 details the MOEs and MOPs influencing the Adjusted Sortie Schedule, according to the present authors. Some measures detailed include Maintenance Plane Rate (and the similar measure of Maintenance Delivery Reliability) and Aircraft Scheduling Effectiveness (influenced by Maintenance Turn Time and On-Schedule Take-off Time). Note that some mathematical equations are provided to show the path from high-level to low-level measures.

***Total Flyable Rate Hierarchy.*** Figure 28 details the MOEs and MOPs influencing the Total Flyable Rate. Some of the measures detailed include Aircraft Possessed Hours, MC Rate (influenced by Fully and Partially MC Rates), and NMC Rate (Figure 29). The NMC Rates most relevant to Total Flyable Rate are those that classify an aircraft as Airworthy (e.g., flyable). As before, some mathematical equations are provided to show the path from high-level to low-level measures.

***Not Mission Capable (NMC) Rate Hierarchy.*** Figure 29 shows, in detail, the MOEs and MOPs included in evaluating NMC Rate. Some of the measures detailed include Aircraft Possessed Hours, and Total NMC (influenced by both Airworthy and Not Airworthy measures). Each level of the NMC Rate hierarchy expands into measures of maintenance, supply, scheduled events, and unscheduled events. The measures are grouped in the categories of “Airworthy” and “Not Airworthy.” As before, some mathematical equations are provided to show the path from high-level to low-level measures.

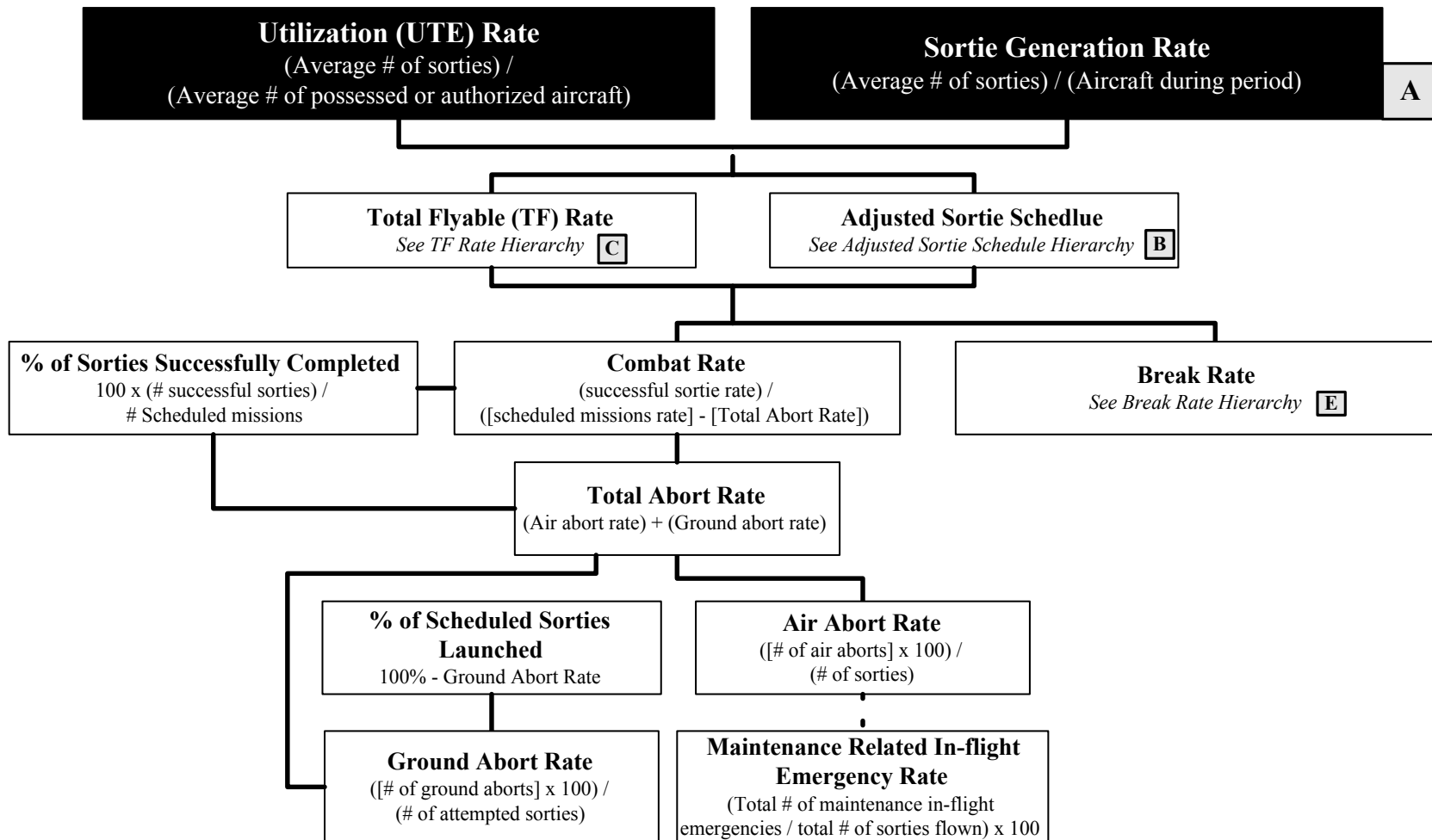
***Break Rate Hierarchy.*** Figure 30 shows the MOEs and MOPs included in evaluating Break Rate. It is important to note that the Break Rate is influenced by systems and parts reliability measures. Some of the Break rate measures detailed include Fix Rate, Mean Time Between Maintenance Actions, and Mean Down Time (influenced by Mean Repair Time, Manpower UTE rate, and Maintenance Man-Hours). As before, some mathematical equations are provided to show the path from high-level to low-level measures.

***Mean Down Time Hierarchy.*** Figure 31 shows the MOEs and MOPs included in evaluating Mean Down Time. Some of the measures of mean down time detailed include Turn Time, Mean Repair Time; Manpower UTE rate, and Maintenance Man-Hours. As before, some mathematical equations are provided to show the path from high-level to low-level measures.



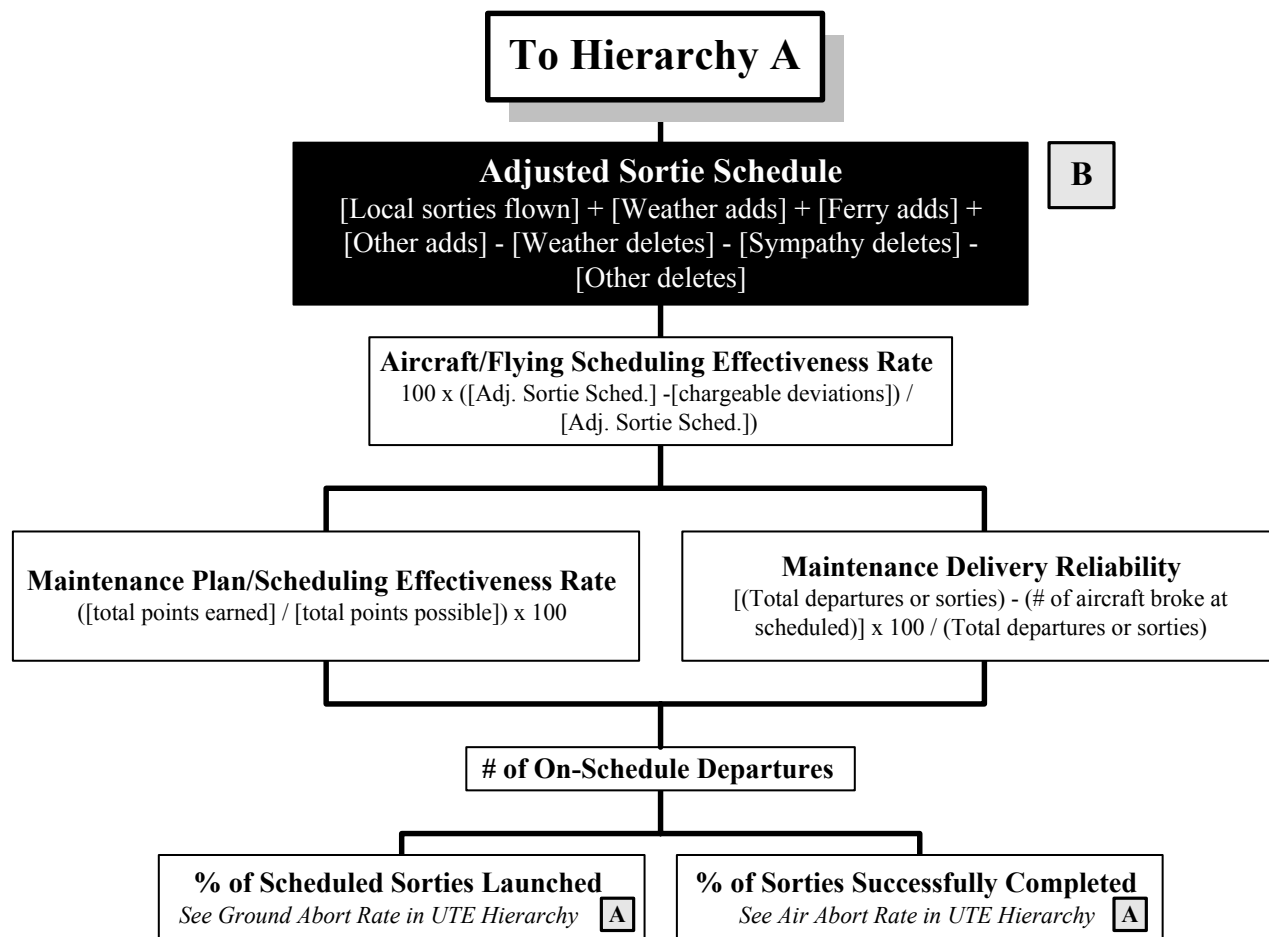
**FIGURE 25. Utilization/Sortie generation rate hierarchy (overview diagram).**

Developed by Crew System Ergonomics Information Analysis Center (CSERIAC) operated by the University of Dayton Research Institute (UDRI). Copyrighted 1996©: The University of Dayton. All commercial rights reserved. This material may be reproduced by or for the U.S. Government pursuant to the copyright license under the clause at 52.227-7013 (October 1996).



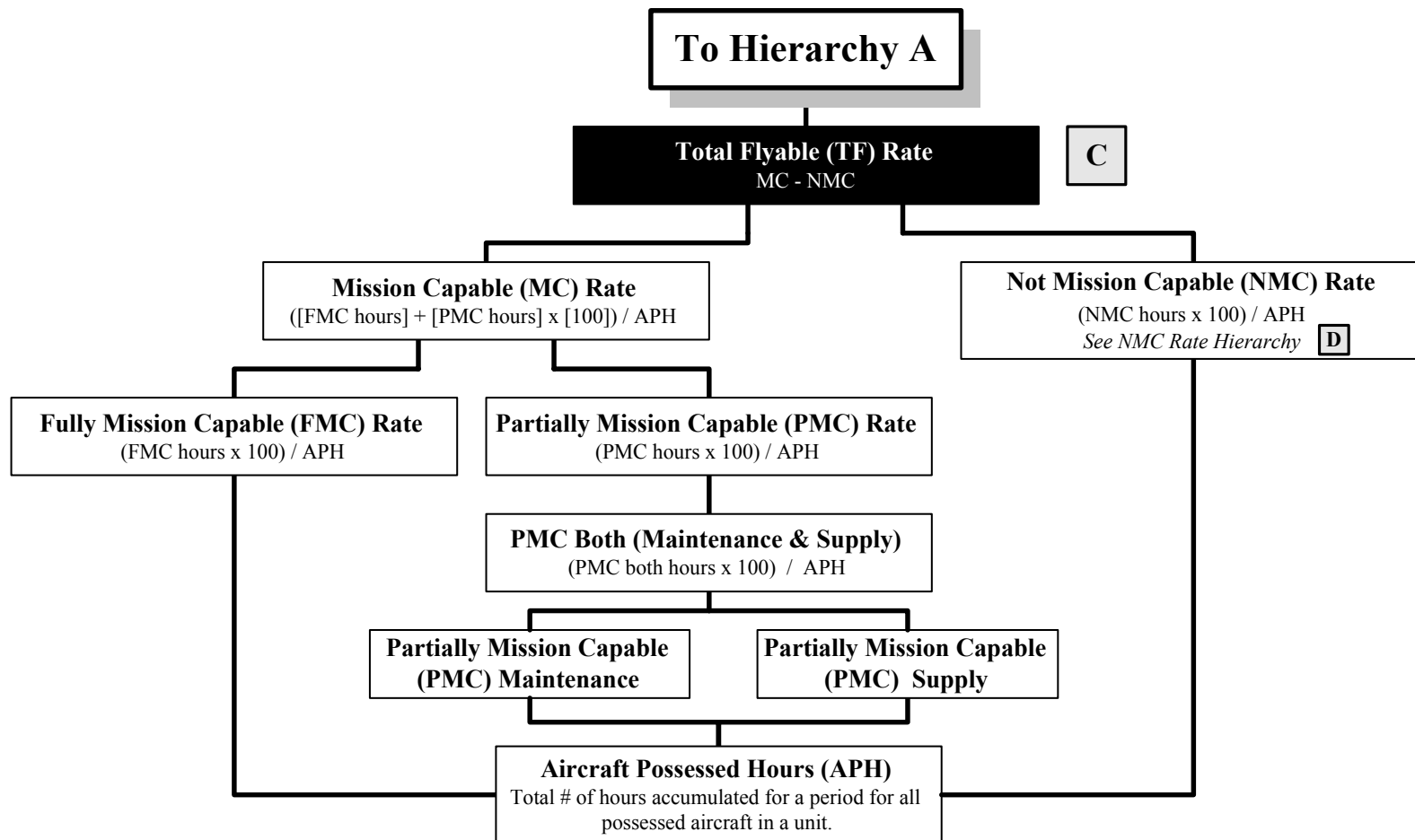
**FIGURE 26. Utilization/Sortie generation rate hierarchy (top level).**

Developed by CSERIAC operated by the UDRI. Copyrighted 1996©: The University of Dayton. All commercial rights reserved. This material may be reproduced by or for the U.S. Government pursuant to the copyright license under the clause at 52.227-7013 (October 1996).



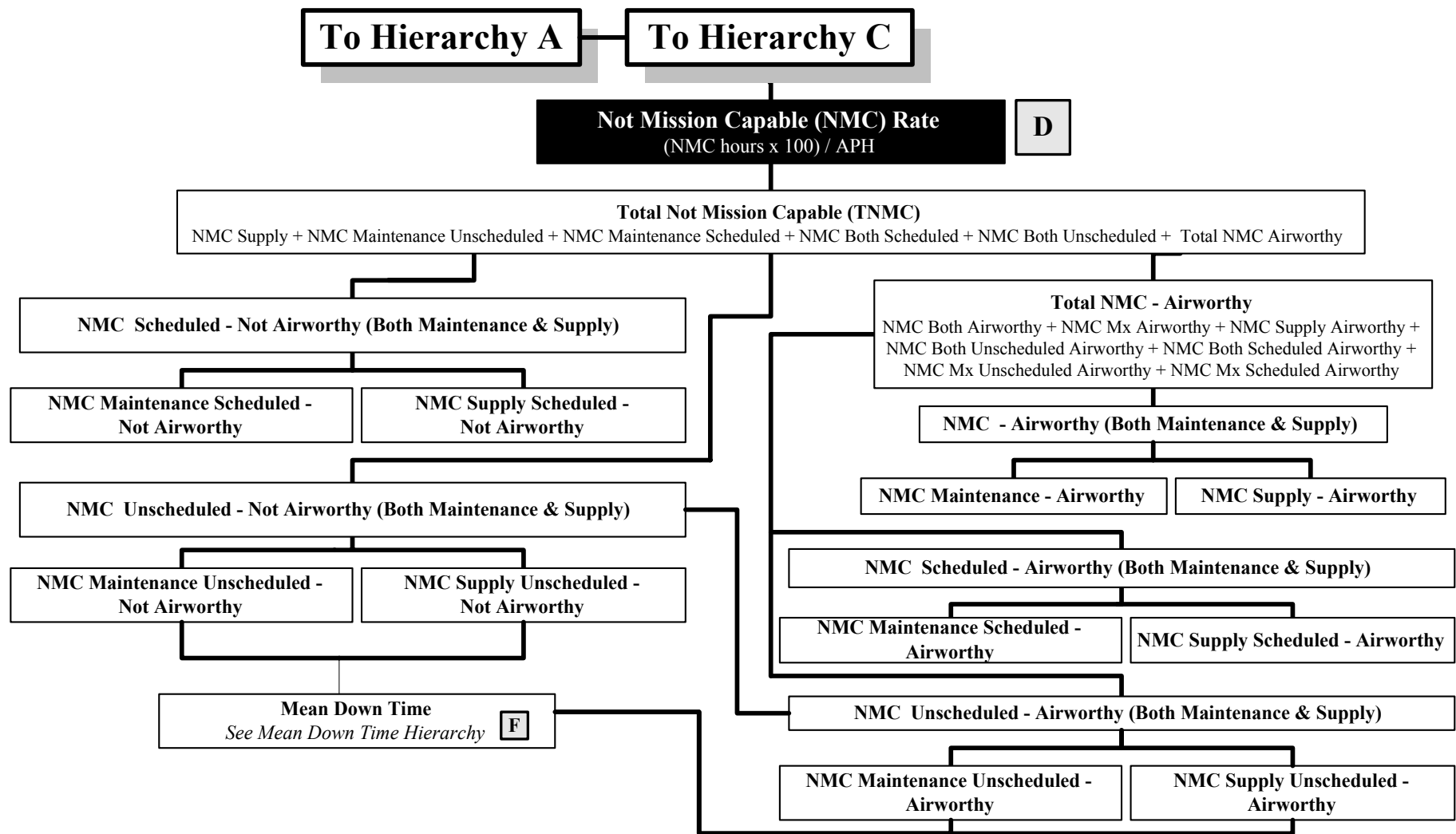
**FIGURE 27. Adjusted sortie schedule hierarchy.**

Developed by CSERIAC operated by the UDRI. Copyrighted 1996©: The University of Dayton. All commercial rights reserved. This material may be reproduced by or for the U.S. Government pursuant to the copyright license under the clause at 52.227-7013 (October 1996).



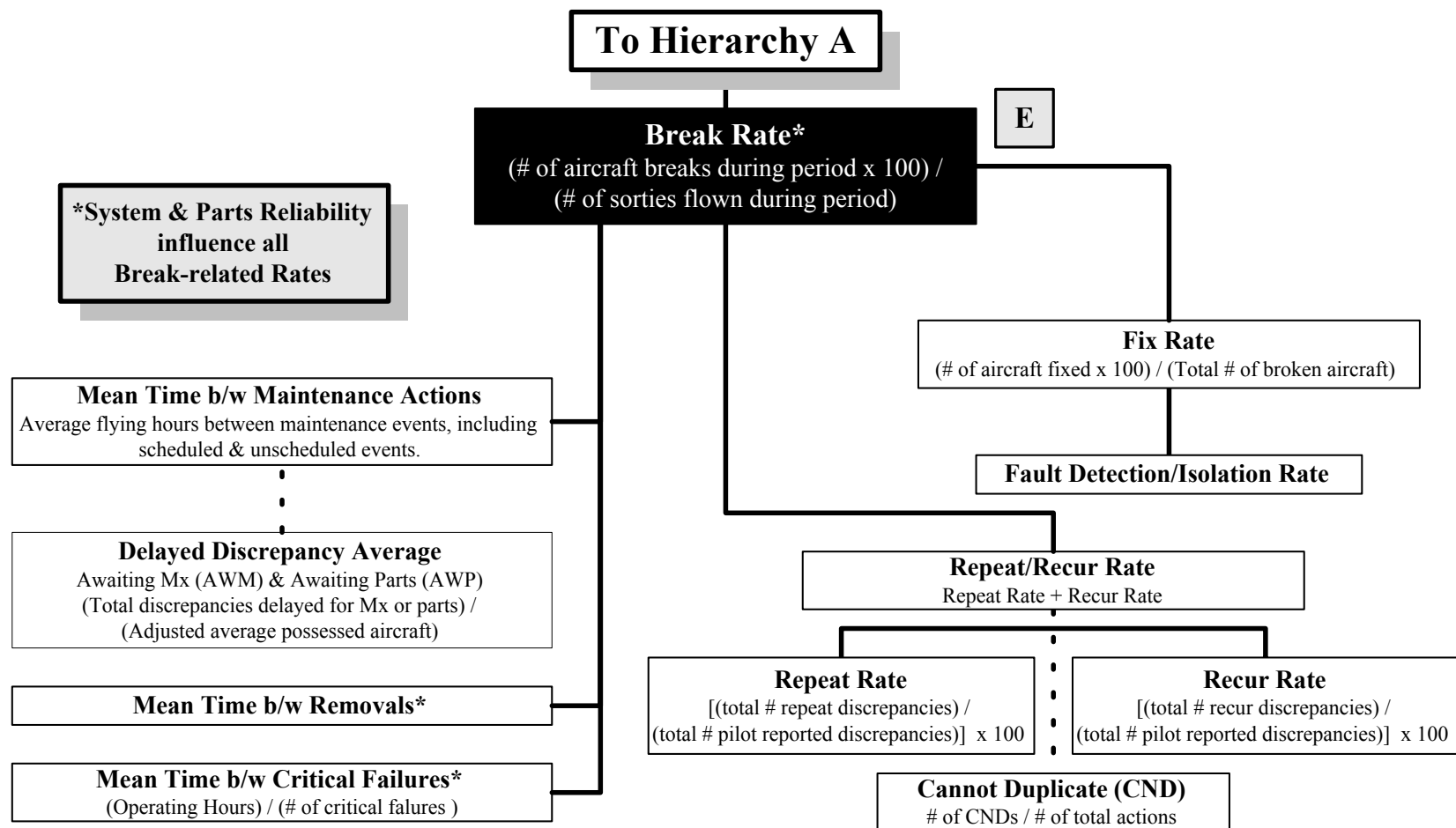
**FIGURE 28. Total flyable rate hierarchy.**

Developed by CSERIAC operated by UDRI. Copyrighted 1996©: The University of Dayton. All commercial rights reserved. This material may be reproduced by or for the U.S. Government pursuant to the copyright license under the clause at 52.227-7013 (October 1996).



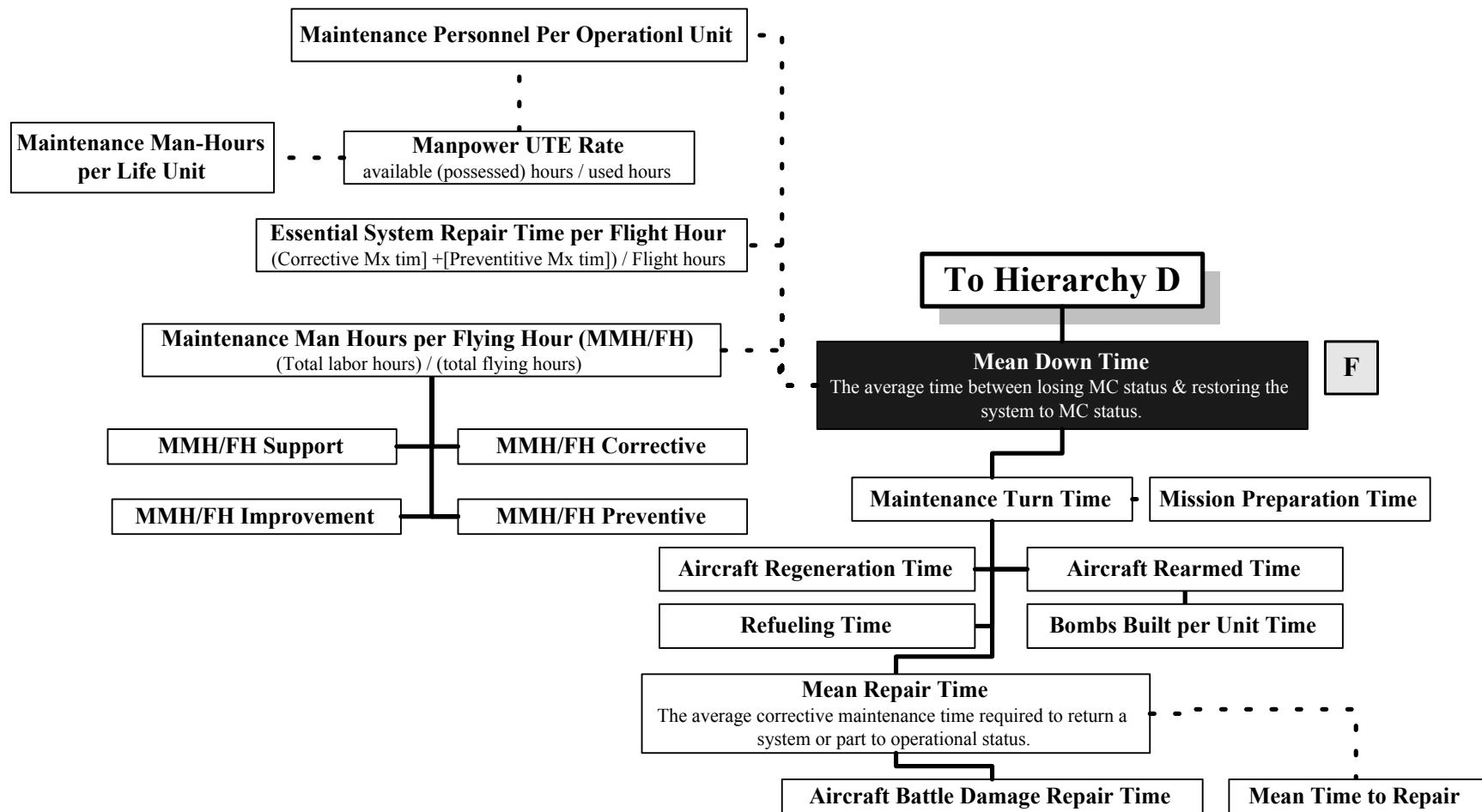
**FIGURE 29. Not mission capable rate hierarchy.**

Developed by CSERIAC operated by UDRI. Copyrighted 1996©: The University of Dayton. All commercial rights reserved. This material may be reproduced by or for the U.S. Government pursuant to the copyright license under the clause at 52.227-7013 (October 1996).



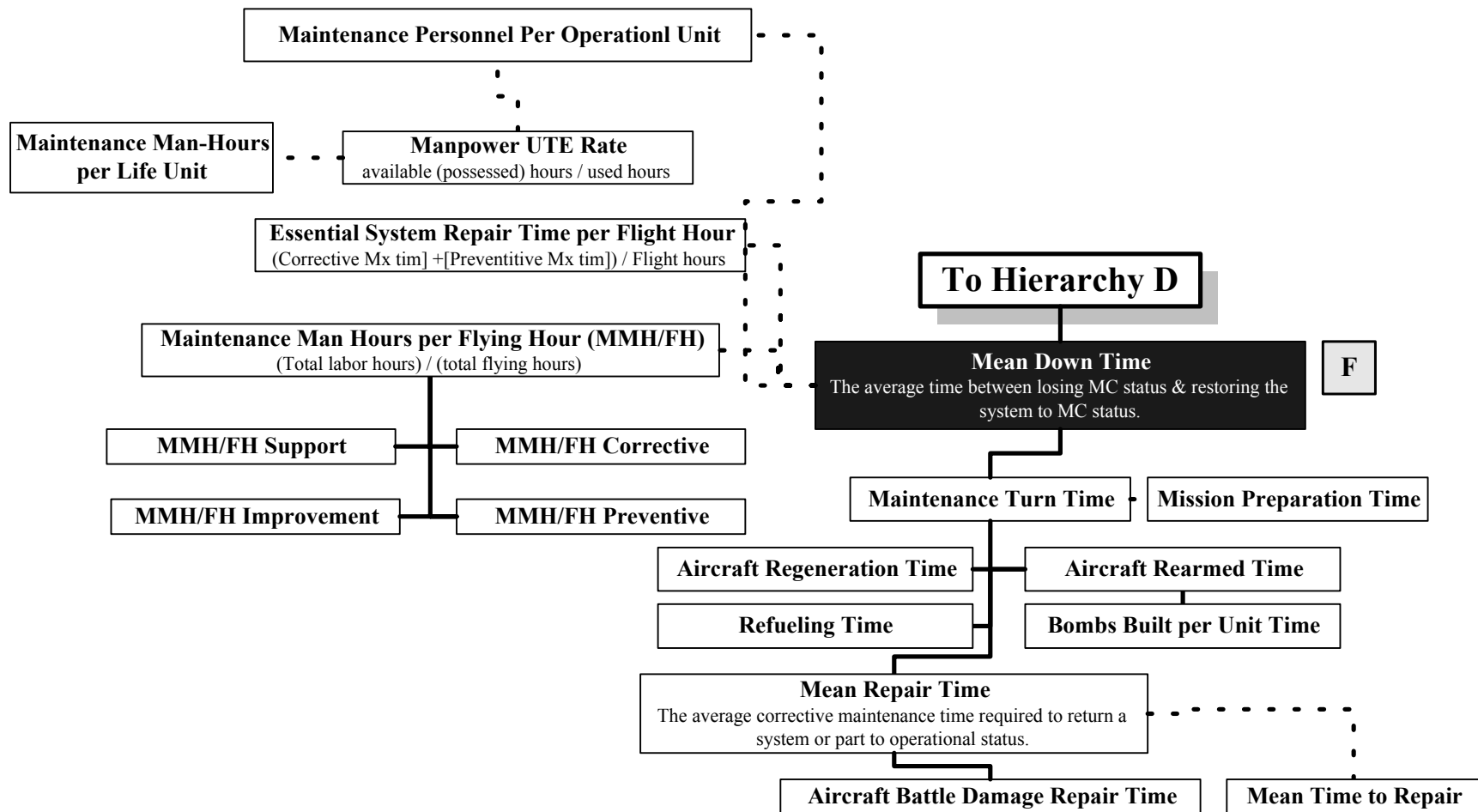
**FIGURE 30. Break rate hierarchy.**

Developed by CSERIAC operated by UDRI. Copyrighted 1996©: The University of Dayton. All commercial rights reserved. This material may be reproduced by or for the U.S. Government pursuant to the copyright license under the clause at 52.227-7013 (October 1996).



**FIGURE 31. Mean down time hierarchy.**

Developed by CSERIAC operated by UDRI. Copyrighted 1996©: The University of Dayton. All commercial rights reserved. This material may be reproduced by or for the U.S. Government pursuant to the copyright license under the clause at 52.227-7013 (October 1996).



**FIGURE 32. Mean down time hierarchy.**

Developed by Crew System Ergonomics Information Analysis Center (CSERIAC). Copyrighted 1996©: The University of Dayton. All commercial rights reserved. This material may be reproduced by or for the U.S. Government pursuant to the copyright license under the clause at 52.227-7013 (October 1996).

## 8. Utilizing Maintenance MOEs/MOPs to Evaluate the Operational Effectiveness of Training

One of the primary goals of this study was to determine how MOEs/MOPs related to the operational performance of a flying unit and whether these measures could be used to evaluate the effectiveness of training. In this context, performance can be defined as the degree that a unit can accomplish its mission, and where “to accomplish its mission” can be defined as the ability of a unit to produce successful sorties. Therefore, simplifying the above, at least from a maintenance point of view, the primary goal of a maintenance unit is to produce sorties.

### ***Mission Capable (MC) Rate as a Primary Measure of Operational Capability***

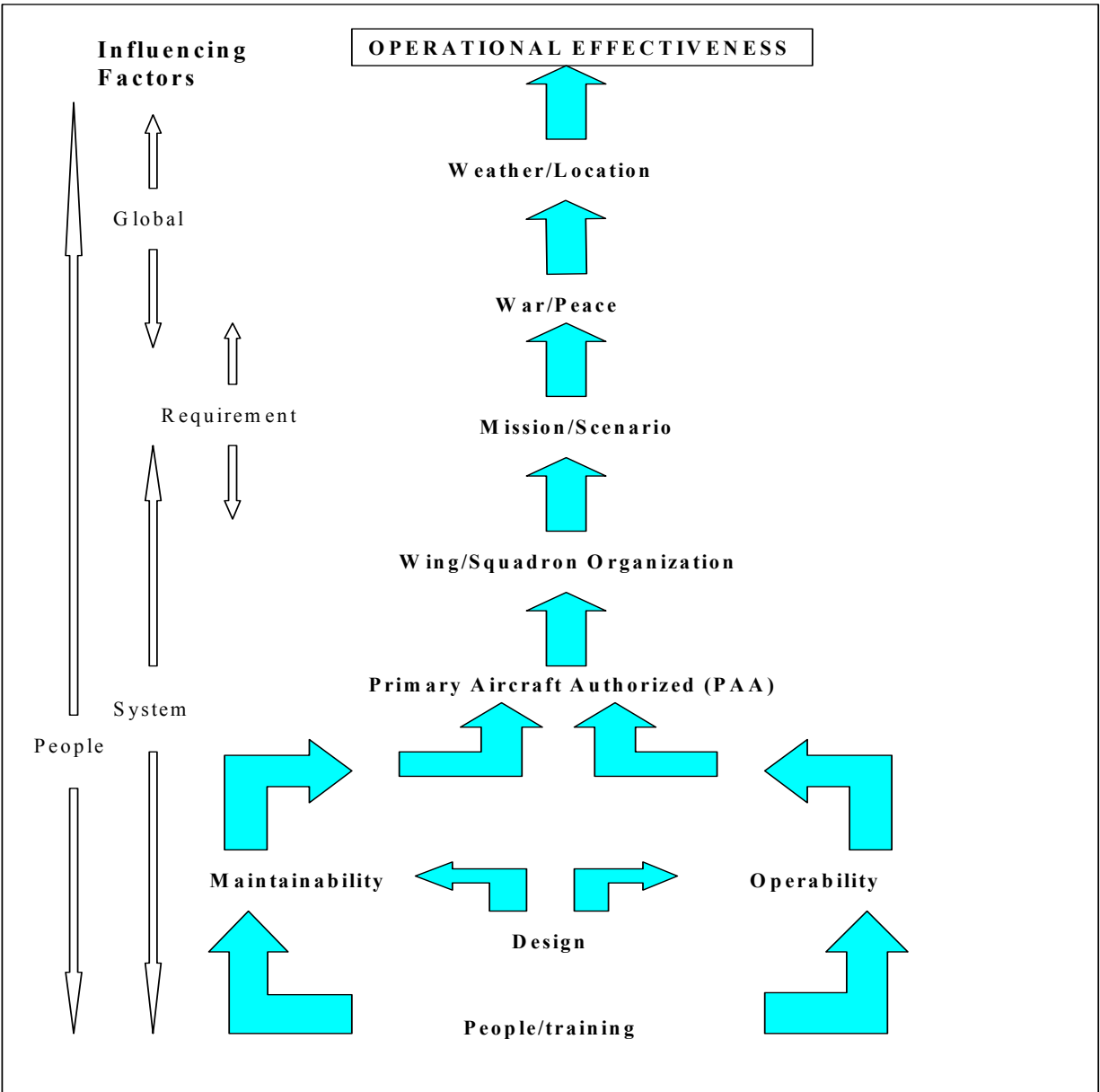
The production of sorties is one of the primary Measures of Effectiveness (MOE) used to evaluate Air Force flying units. The ability to produce sorties can be measured by Sortie Generation Rate (Average # of sorties/possessed aircraft during the period) or Utilization Rate (Average # of sorties/Average # of possessed or authorized aircraft) or less directly by Total Flyable (TF) Rate (Mission Capable Rate – Non Mission Capable Rate) or Mission Capable (MC) Rate ( $[\text{Fully Mission Capable hours} + \text{Partially Mission Capable hours}] \times 100 / \text{Aircraft Possessed hours [APH]}$ ). All of these measures are fairly similar in nature, all provide a relatively good measure of a squadron’s ability to produce sorties, but probably the best of these measures to assess the ability of a maintenance unit to produce sorties is Mission Capable (MC) rate. Rather than measure actual sorties produced, MC measures the “potential” of a unit to generate sorties. MC, as shown above, reflects the ratio (in hours) that the aircraft is mission ready, to total aircraft possessed hours. MC is a better measure to evaluate maintenance than sorties, since MC does not reflect the lack of pilots, sorties lost due to weather, or other factors not related to maintenance.

### ***Factors that Influence Operational Effectiveness***

Even though MC is probably the best measure available, its use is not without problems. All of the following items (this is only a sampling – not a complete list), to one degree or another, affect MC rate:

- Number of aircraft in the squadron or wing
- Facilities of the base
- Supply system
- Type of missions flown
- Flying schedule
- Maintenance policies
- Experience and training of maintenance personnel

The factors that can affect the ability of a maintenance unit to produce sorties can be arranged in a hierarchy of influence (See Figure 33). The lowest level of the hierarchy starts with “people issues,” such as number of technicians, and the experience and training of maintenance personnel. People issues are pervasive across the entire range of the hierarchy, not just the bottom. For example, the number of technicians required is normally influenced by the reliability of the system, organizational structure of the unit, and type of missions flown. Higher up in the hierarchy, and overlapping people issues, are system considerations. System considerations are items such as system operability, maintainability and reliability. The inherent maintainability and operability of a system along with the skill, and organization structure of the technicians, drives the number of maintainers needed, and the ability of the unit to produce sorties. Further up the hierarchy, requirement issues such as the type of mission flown, and scenario requirements, coupled with the inherent qualities of the system, and the number, skill and training of the technicians influences the capability of the system. At the top of the hierarchy are global issues, such as whether missions are being flown in war time or peace time, and environmental issues, driven by the location the system is being operated in, such as heat, cold, dust, rain, etc.



**FIGURE 33. Hierarchy of factors that influence operational effectiveness**

### ***Measuring Changes In Operational Capability***

If all of these factors collectively affect MC Rate and the unit's ability to generate sorties and perform its mission, how could one demonstrate that a single item, for example training (one of the lowest items on the hierarchy), would have an impact on a unit's ability to fly sorties? Questions that must, therefore be asked include the following: First, what do maintenance technicians and the systems they support, derive from improved training? Will the technician perform tasks faster with fewer errors, and will faster repair times result in higher MC rates and more sorties? To evaluate the effect of improving training on a units operational capability, data could be collected concerning the time it takes trainees to perform repairs prior to training, their performance time after training, and then an evaluation can be made to relate the change in repair times to a change in MC rate.

## ***Maintenance Data Collection (MDC) Issues***

Even though the above approach appears straightforward, execution is not. Collecting or extracting information concerning the time it takes a technician to perform a task is not a simple and direct process since the Maintenance Data Collection, Core Automated Maintenance System (CAMS) was not designed to give visibility into the performance of individual technicians. Tasks are collected and summed by task ID. Maintenance analysts would have to tailor queries using the technician's employee number to be able to extract and sum actions identified to the maintenance analyst.

An additional complication in using MDC data for measuring individual performance is that maintenance technicians may record repair times in several different ways. For example, if a technician spends a considerable amount of time troubleshooting a problem, or removing or replacing a part, or verifying that a part is working correctly, the technician may record a separate entry for each segment of the repair. On a different day or time the technician might elect to record the repair as one total time. This total repair time would include the time spent troubleshooting, verifying, and removing and replacing parts. To correlate as much collected data as possible, Maintenance Analysis would need to sum all maintenance segments associated with a particular maintenance task (event ID) into a total time. By summing the data in this way, all maintenance tasks would be based on total repair time, and would therefore be comparable. Another complicating factor is that trying to gather sufficiently data on a particular task for analysis can be difficult since most aircraft today are very reliable. Many months may elapse before a technician is assigned to work a particular subsystem on which data needs to be collected. Thus, data must be collected over a fairly long length of time to ensure that enough are collected to be statistically significant.

## ***Difficulties in Assessing the Effect of Maintenance Variables on Sortie Production***

The ability to assess the impact of a change in one maintenance measure on the operational capability of an Air Force flying organization is formidable. Many measures can be used to assess operational capability, and many more are needed to measure maintenance capability. All of these measures are intertwined and dependent. For example, training time affects Repair Time, and Repair Time affects Maintenance Turn Time, and Maintenance Turn Time affects Mean Down Time, and Mean Down Time affects Mission Capable (MC) Rate, etc., but reliability, maintenance policies, weather, and a "million" other things also affect MC rate. The further one moves up the hierarchy, the harder it is to identify the affect of one single lower-level item. Each step up adds complexity and uncertainty to the result. The only way to resolve the question addressed would be to perform a comprehensive study, collect sufficient data, and test assumptions. It would appear this kind of study would be very useful to Air Force decision-makers and planners. Insight into which areas, when improved, would provide the most payoff would be highly desirable to decision-makers at all organizational levels.

## **9. Aircrew-System Performance Taxonomy**

Recent improvements in available technology offer new opportunities for simulation to increase the comprehensiveness and realism of aircrew mission training. The concept of Distributed Mission Training (DMT) offers significant promise for increased realism and enhanced training at reduced cost and risk by substituting simulation for carefully selected aspects of the mission. In an era of declining defense dollars, it is imperative that every effort is made to maximize efficiency. By identifying and examining war-fighter tasks and their metrics, then designing training around these identified skills and using the same measurement criteria as field commanders, it may be possible to increase combat capability at reduced training cost. This section presents aircrew mission tasks and related metrics as an *Aircrew-System Performance Taxonomy*. It is organized in consonance with the AFTL (AFDD 1-1, 1998), includes input from the UJTL, and various other regulations and other documents detailed below. It provides supplemental aircrew-system tasks and related MOEs/MOPs not found in the AFRL.

## **Considerations in Developing Aircrew MOE Taxonomy**

The aircrew portion of the *Aeronautical Human-System MOE/MOP Taxonomy* comprises aircrew tasks, MOEs/MOPs, evaluation criteria, and references. In general, it has been organized to follow the nomenclature and order of the AFTL. Where new tasks or metrics were identified that were not contained in the AFTL, these tasks or MOEs/MOPs have been inserted to compliment the AFTL organization. While the original aircrew portion of the taxonomy was collected from many sources, the AFTL now forms the primary structure. Although the taxonomy is configured in the AFTL order, it also contains detailed information gathered from four aircrew evaluation Air Force Instructions (AFIs) or Multi-Command Instructions (MCIs), combined with the original aircrew taxonomy developed initially in 1996.

The UDRI-HFG determined that detailed criteria currently used for evaluation of aircrew mission performance are contained in a series of airframe-specific AFIs, MCIs, and related manuals and handbooks. Required operator tasks and specific evaluation measures used for each airframe are contained in the respective documents of this series (AFI/MCI 11-2). Our expectation is that, when fully developed, METLs and MOEs will reflect the general content of current evaluation measures contained in these documents. Funds and time permitted examination of only four of these AFI/MCIs regarding aircrew evaluation criteria. These AFIs/MCIs covering the A/OA-10, F-16, F-15C (Draft), and F-15E (Draft) were chosen to augment the initial published version of the *Aircrew-System MOE/MOP Taxonomy* (Best, Gentner, Cunningham, Schopper, & Morris, 1997). These aircraft were selected as typical examples of the type of hierarchical development that is expected in follow-on enhanced versions of the *Aircrew-System MOE/MOP Taxonomy* and that might be immediately useful for DMT.

This revision of the original aircrew portion (1996) of the taxonomy began when the Air Force Doctrine Center received approval of the new AFTL (August 1998). The intent of this second phase of the taxonomy development effort was to expand and amplify the original taxonomy while avoiding duplication of what was learned from the initial development. To this end, this work focused on the actual *aircrew tasks and measures* by the Air Force, DoD, other services, and other sources. Then, the other sources available from the initial 1996 version were fit into the structure of the AFTL. Those items that did not neatly fit within the AFTL structure were added to the end of the taxonomy, so as to preserve the numbering system of the AFTL in the first seven major categories.

## **Aircrew Taxonomy Organization**

The tasks and measures contained in this section are presented in a format similar to the Air Force Task List (AFDD 1-1, 1998).

Table 11 shows a broad overview of the AFTL structure. Where possible, we have incorporated the specific identifying nomenclature used in that document in an effort to simplify the structure of this section.

The AFTL subtasks labeled x.x.2 (Educate and Train), x.x.3 (Equip), and x.x.4 (Plan) have been omitted, as they tend not to identify unique aircrew tasks and can be inferred from each task since they are the same for every task. When we found tasks or metrics that were not contained in the AFTL we added them as subheadings or as additional tasks and metrics where they best seemed to fit with the overall outline of the AFTL.

**TABLE 11. Summary of AFTL structure.**

TASK/TITLE	TAXONOMY STATUS
AFT. X Provide "Core Competency"	USED
AFT. X.X Provide "Capability"	USED
AFT. X.X.1 "Perform" task	USED
AFT. X.X.2 "Educate and Train" forces	NOT USED
AFT. X.X.3 "Equip" forces	NOT USED
AFT. X.X.4 "Plan" task	NOT USED

The *Aircrew-System MOE/MOP Taxonomy* is organized hierarchically by Air Force core task, specific Air Force Tasks (AFTs), then by subtasks and other metrics identified in this study. An overview of the Aircrew-Systems Taxonomy Hierarchy is presented in Table 12. The source for the task or metric is listed beside each item. Items that have no comparable AFT are identified. This taxonomy is builds upon the original *Aircrew-System Taxonomy* constructed in 1996-1997 by Best, Gentner, Cunningham, Schopper, and Morris (1997).

**TABLE 12. Aircrew-System Taxonomy Hierarchy.**

AFT 1. PROVIDE AIR AND SPACE SUPERIORITY
AFT 1.1 Provide Counterair Capabilities
AFT 1.1.1 Perform Counterair Functions
AFT 1.1.1.1 Conduct Offensive Counterair (OCA)
AFT 1.1.1.2 Conduct Defensive Counterair (DCA)
AFT 1.2 Provide Counter Space Capabilities
AFT 1.2.1 Perform Counterspace Functions
AFT 1.2.1.1 Conduct Offensive Counter Space (OCS)
AFT 1.2.1.2 Conduct Defensive Counter Space (DCS)
ETD 1.3 Theater Missile Defense (TMD ) (No comparable AFT)
ETD 1.4 General Air Combat Measures (No comparable AFT)
ETD 1.5 Air Combat Tactics (No comparable AFT)
ETD 1.6 Low Altitude Air-to-Air Employment (No comparable AFT)
ETD 1.7 Suppression of Enemy Air Defenses (SEAD) (No comparable AFT, ACC MAP 1)
ETD 1.7.1 Lethal Suppression of Enemy Air Defenses (SEAD) (No comparable AFT, ACC MAP 1)
ETD 1.7.2 Nonlethal Suppression of Enemy Air Defenses (SEAD) (No comparable AFT, ACC MAP 1)
AFT 2. PROVIDE PRECISION ENGAGEMENT
AFT 2.1 Provide Lethal Precision Engagement Capabilities
AFT 2.1.1 Perform Lethal Precision Engagement Functions
AFT 2.2 Provide Nonlethal Precision Engagement Capabilities
AFT 2.2.1 Perform Nonlethal Precision Engagement Functions
AFT 2.3 Provide Combat Search and Rescue (CSAR) Capabilities
AFT 2.3.1 Perform CSAR Functions

**TABLE 12. Aircrew-System Taxonomy Hierarchy (cont.)**

ETD 2.3.5 Combat Search and Rescue Measures (ACC Map 4)
ETD 2.3.6 Tactical Aeromedical Evacuation (AIREVAC)
AFT 3. INFORMATION SUPERIORITY
AFT 3.1 Provide Information Operations Capabilities
AFT 3.1.1 Perform Information Operations Functions
AFT 3.1.1.1 Perform Information-in-Warfare Functions
AFT 3.1.1.1.1 Perform Intelligence Activities
AFT 3.1.1.1.2 Perform Surveillance
AFT 3.1.1.1.3 Perform Reconnaissance
AFT 3.1.1.1.4 Perform Weather Service
AFT 3.1.1.1.5 Perform Navigation and Positioning Functions
AFT 3.1.1.1.6 Perform Information Transmission and Storage
AFT 3.1.1.1.7 Perform Public Affairs Activities
AFT 3.1.1.2 Perform Information Warfare
AFT 3.1.1.2.1 Perform Counter-Information
AFT 3.1.1.2.1.1 Perform Offensive Counter-Information (OCI)
AFT 3.1.1.2.1.1.1 Conduct Psychological Operations (PSYOP)
AFT 3.1.1.2.1.1.2 Conduct Electronic Warfare (EW)
AFT 3.1.1.2.1.1.3 Conduct Military Deception
AFT 3.1.1.2.1.1.4 Conduct Physical Attack
AFT 3.1.1.2.1.1.5 Conduct Information Attack
AFT 3.1.1.2.1.2 Perform Defensive Counter-Information (DCI)
AFT 3.1.1.2.1.2.1 Perform Information Assurance
AFT 3.1.1.2.1.2.1.1 Provide Information Availability
AFT 3.1.1.2.1.2.1.2 Provide Information Integrity
AFT 3.1.1.2.1.2.1.3 Provide Information Authenticity
AFT 3.1.1.2.1.2.1.4 Provide Information Nonrepudiation
AFT 3.1.1.2.1.2.1.5 Provide Information Confidentiality
AFT 3.1.1.2.1.2.1.6 Provide Restoration of Information and Information Systems
AFT 3.1.1.2.1.2.2 Conduct OPSEC
AFT 3.1.1.2.1.2.3 Conduct Counterintelligence
AFT 3.1.1.2.1.2.4 Conduct Counter PSYOP
AFT 3.1.1.2.1.2.5 Conduct Electronic Protection (EP)
AFT 3.1.1.2.1.2.6 Conduct Counterdeception
ETD 3.2 Counter-Drug Operations (No comparable AFT, AFI 11-2F-16)
AFT 4. PROVIDE GLOBAL ATTACK (ACC MAP 2)
AFT 4.1 Provide Strategic Attack Capabilities ( ACC MAP 2)
AFT 4.1.1 Perform Strategic Attack
AFT 4.1.1.1 Demoralize the Enemy
AFT 4.1.1.2 Degrade Enemy Assets
AFT 4.2 Provide Counter-land Capabilities

**TABLE 12. Aircrew-System Taxonomy Hierarchy (cont.)**

AFT 4.2.1 Perform Counter-land Functions
AFT 4.2.1.1 Interdict Enemy Landpower (ACC MAP 2)
ETD 4.2.1.1.1 General Interdiction Analysis Measures (No comparable AFT)
AFT 4.2.1.1.1 Close Air Support (CAS) (ACC MAP 2)
ETD 4.2.1.2.1 Forward Air Control (No Comparable AFT – AFI 11-2A/OA-10)
ETD 4.2.1.2.2 Air Strike Control (ASC) (No Comparable AFT – AFI 11-2F16)
AFT 4.2.1.3 Conduct Airborne Operations
AFT 4.2.1.4 Support Amphibious Operations Functions
AFT 4.3 Provide Countersea Capabilities
AFT 4.3.1 Perform Countersea Functions
AFT 4.3.1.1 Interdict Enemy Sea Power
AFT 4.3.1.2 Conduct Antisubmarine Warfare
AFT 4.3.1.3 Conduct Aerial Minelaying Operations
AFT 4.4 Provide Special Operations Forces (SOF) Employment Capabilities
AFT 4.4.1 Perform Special Operations Forces (SOF) Employment Functions
AFT 5. PROVIDE RAPID GLOBAL MOBILITY
AFT 5.1 Provide Airlift Capabilities
AFT 5.1.1 Perform Airlift
AFT 5.2 Provide Air Refueling Capabilities
AFT 5.2.1 Perform Air Refueling
AFT 5.3 Provide Spacelift Capabilities
AFT 5.3.1 Perform Spacelift
AFT 5.4 Provide Aerospace Expeditionary Force (AEF) Capabilities
AFT 5.4.1 Perform AEF Functions
ETD 5.5 Strategic and Theater Aeromedical Evacuation (AE) (No comparable AFT )
ETD 5.5.1 Perform Strategic Aeromedical Evacuation (AE) (No comparable AFT)
ETD 5.5.2 Perform Theater Aeromedical Evacuation (AE) (No comparable AFT)
AFT 6. PROVIDE AGILE COMBAT SUPPORT
AFT 7. PROVIDE COMMAND AND CONTROL
AFT 7.1 Monitor Global Conditions and Events
AFT 7.1.1 Receive, Maintain, Integrate, and Display Data From All Sources
AFT 7.1.2 Monitor Status of Global Actions, Critical Events, Crisis Areas
AFT 7.1.3 Monitor Physical Environment Conditions
AFT 7.1.4 Monitor Status of Friendly Forces
AFT 7.1.5 Monitor Status of Nonfriendly Forces
AFT 7.1.6 Monitor Rules of Engagement, Treaties, and Agreements
AFT 7.2 Assess Global Conditions and Events
AFT 7.2.1 Determine and Assess the Nature and Impact of Critical Events
AFT 7.2.2 Assess Friendly and Nonfriendly Force and Resource Status
AFT 7.2.3 Assess Friendly and Nonfriendly Operations and Results
AFT 7.2.4 Determine the Military Implications of Fused Intelligence Indicators. All-source

**TABLE 12. Aircrew-System Taxonomy Hierarchy (cont.)**

Information, and Orders of Battle
AFT 7.2.5 Assess Event Relative to Rules of Engagement (ROE), Treaties, and Agreements
AFT 7.2.6 Assess Termination Options, Conditions, and Proposals
AFT 7.3 Plan Military Operations
AFT 7.3.1 Formulate Operations Objectives
AFT 7.3.2 Merge, Generate, and Tailor Force List and Force Movements Requirements
AFT 7.3.3 Develop Potential Courses of Action (COAs)/Plans
AFT 7.3.4 Evaluate Proposed COAs/Plans
AFT 7.3.5 Select COA/Plan
AFT 7.4 Execute Military Operations
AFT 7.4.1 Execute COA/Plan
AFT 7.4.2 Disseminate Information
ETD 8.1 General Tactical Measures (No comparable AFT, AFIs 11-2 F-16 and 11-2A/OA-10)
ETD 8.2 Air-to-Surface Measures (No comparable AFT, AFI 11-2F-16 , AFI 11-2A/OA-10 and AFI 11-2F-15E Draft)
ETD 8.3 Surface Attack / Surface Attack Tactics and Measures (No comparable AFT, AFI 11-2F-16 and AFI 11-2A/OA-10)
ETD 8.4 Air-to-Ground Gunnery Events and Measures (No comparable AFT, AFI 11-2F-16 and AFI 11-2A/OA-10)
ETD 8.5 Low-altitude Tactical Navigation (LATN) (No comparable AFT, AFIs 11-2F-16 & 11-2A/OA-10)
ETD 8.6 Low-Altitude Tactical Formation (LATF) (No comparable AFT, AFI 11-2F-16 and AFI 11-2A/OA-10)
ETD 8.7 Killer scout tactics (No comparable AFT, AFI 11-2/F16)
ETD 8.8 Air-to-air and air-to-ground targeting (No comparable AFT)
ETD 9. OTHER FLIGHT PERFORMANCE MEASURES (No comparable AFT)
ETD 9.1 Detectability (No comparable AFT)
ETD 9.2 Survivability (No comparable AFT)
ETD 9.3 Vulnerability (No comparable AFT )
ETD 10 OTHER HUMAN PERFORMANCE MEASURES (No comparable AFT)
ETD 10.1 Situation awareness (No comparable AFT)
ETD 10.2 Cognitive workload (No comparable AFT)
ETD 10.3 Other (No comparable AFT)

***Air Combat Command Mission Area Plan Summary***

Since the aircraft covered in this update (A/OA-10, F-16, F-15c, and F-15E) are Air Combat Command (ACC) assets, we have included material from ACC Mission Area Plans (MAP) to aid the reader in gaining a clearer understanding of the relationship between some of these tasks and measures. This material is indicated by a separate reference; such as: ACC MAP 4 [Combat Search and Rescue (CSAR)]. Note that in some cases items in the MAPs were not listed in the AFTL. For example, Suppression of Enemy Air Defenses (SEAD) is not mentioned in the AFTL, but it is listed in the MAPs. Table 13 summarizes ACC MAP titles, together with major subareas.

**TABLE 13. Air Combat Command Mission Area Plans (FY98) Executive Summary Listing (ACC/DR, 1998).**

1. Air Superiority
• Counter Air
• Theater Missile Defense (TMD)
• Suppression of Enemy Air Defenses (SEAD)
2. Global Attack
• Strategic Attack
• Interdiction
• Close Air Support (CAS)
3. Agile Combat Support
4. Combat Search and Rescue
5. Surveillance and Reconnaissance

General agreement exists between the AFTL and the ACC MAP as to mission area titles. However, there is less alignment between the actual taxonomic structures of the two documents. Table 14 presents a cross-reference to similar areas within the AFTL and the ACC MAP. This table is by no means intended to be a comprehensive list of the material contained within either document. It is simply an overview.

**TABLE 14. Cross-reference from AFTL to ACC MAP.**

AFT #	Mission Area	ACC MAP #	Mission Area
1	Air superiority	1	Air superiority
1.1	Counter Air	1	Counter Air
1.2	Counter Space	---	----
---	----	1	Theater Missile Defense
---	----	1	Suppression of Enemy Air Defenses (SEAD)
2	Precision Engagement	----	----
2.3	Combat Search and Rescue (CSAR)	4	Combat Search and Rescue (CSAR)
3.1.1.1.2	Surveillance	5	Surveillance
3.1.1.1.3	Reconnaissance	5	Reconnaissance
4	Global Attack	2	Global Attack
4.1	Strategic Attack	2	Strategic Attack
4.2	Counter Land	----	----
4.2.1.1	Interdiction	2	Interdiction
4.2.1.2	Close Air Support	2	Close Air Support

A basic overview of the mission area operational objectives as expressed by ACC is summarized below. Note that some of these mission areas are new while others have been combined since the 1996 version. These summaries are quoted from the ACC Mission Planning Webpage. The URLs for the MAP executive summaries are as follows:

- Air Superiority: [http://www.dr.langley.af.mil/MAST/2page\\_AS.html](http://www.dr.langley.af.mil/MAST/2page_AS.html)
- Agile Combat Support: <http://www.dr.langley.af.mil/MAST/2pageACS.html>
- Global Attack: [http://www.dr.langley.af.mil/MAST/2page\\_GA.html](http://www.dr.langley.af.mil/MAST/2page_GA.html)
- Combat Search and Rescue: [http://www.dr.langley.af.mil/MAST/2pg\\_CSAR%20.html](http://www.dr.langley.af.mil/MAST/2pg_CSAR%20.html)
- Surveillance and Reconnaissance: [http://www.dr.langley.af.mil/MAST/2page\\_SR.html](http://www.dr.langley.af.mil/MAST/2page_SR.html)

In addition, we have summarized the MAPs in bulleted fashion in Attachment 1.

### **ACC MAP Mission 1: Air Superiority**

This Air Superiority MAP examines the Air-to-Air, Theater Missile Defense (TMD), and the Suppression of Enemy Air Defenses (SEAD) portions of offensive and defensive counterair operations. Other counterair tasks, such as neutralizing command and control, aircraft on the ground and their support facilities are covered in other MAPs. However, this MAP only addresses elements of those areas that offer solutions or support to solutions specific to Air Superiority shortfalls.

**Counterair:** The Counterair force structure is composed of fighter aircraft and their associated armament (air-to-air missiles and guns) and various support assets. The operational objective of these counterair units is to conduct offensive counterair (OCA) and defensive counterair (DCA) missions, to defeat the air forces of the adversary. These units must maintain constant readiness to deploy on a moment's notice and then sustain operations as long as required. The primary operational task is to neutralize (prevent from employing weapons or conducting operations against friendly forces through any means available) enemy aircraft (fighters, bombers, helicopters, and other support aircraft) and cruise missiles (CMs; air-to-surface missiles [ASMs] are considered a subset of CMs) in flight. To accomplish this task fighters must detect and identify (ID) airborne enemy threats, employ their fire control systems to attack the targets, ensure their air-to-air weapons destroy or neutralize the threat and survive against threat weapons, all in the presence of countermeasures.

**Theater Missile Defense (TMD):** The TMD force structure is composed of fighter and bomber aircraft and their associated armament and various support assets. In addition, space based assets also contribute significantly toward the successful accomplishment of the TMD mission, which is a subset of counterair. The operational objective of these TMD units is to conduct OCA and DCA TMD missions to reduce sortie generation and prevent weapons of mass destruction (WMD) proliferation. The primary operational tasks are to neutralize ballistic missiles (BMs) in flight and on the ground and to neutralize WMD production and storage. To accomplish this task TMD assets must detect, track, and ID enemy BM threats, task the appropriate shooter asset, attack and kill the target (either in an offensive or defensive posture), and assess and report the level of success against a particular threat. NOTE: The Air Force also relies on sister Services to provide forces that complement the layered or multi-tiered defensive scheme of TMD.

**SEAD:** The SEAD force structure is composed of fighter aircraft and their associated armament, support jammers and various other support assets, including off-board targeting systems. The operational objective of SEAD is to neutralize air defense forces through lethal and non-lethal means. The primary operational tasks are to defeat fixed and mobile surface-to-air threats. Lethal SEAD platforms must be capable of both reactive suppression and preemptive destruction of an enemy's Integrated Air Defense System (IADS). Reactive suppression requires fighters to detect and identify (ID) and locate surface-to-air threats, employ weapons in a time critical environment to protect friendly forces from hostile engagement. The preemptive destruction mission allows more flexibility in targeting (off-board targeting is possible) with the objective being to locate and destroy mobile and fixed targets in advance of a strike package at a time of our choosing. Non-lethal SEAD platforms assist attack force assets in accomplishing mission by employing ECM against radars and communications (voice/datalink) systems, IFF, ATC systems, AWACS and navigation systems to allow the lethal SEAD and attack assets to marshal, penetrate, and egress selected target areas, thereby increasing their survivability. Specifically the operational tasks consist of radar jamming by EF-111A/EA-6B aircraft and counter C<sup>2</sup> by EC-130 Compass Call aircraft.

## ***ACC MAP Mission 2: Global Attack***

Global Attack (GA) highlights a unique characteristic of the Air Force – its ability to rapidly attack any point on the globe in a matter of hours. The GA MAP documents the modernization roadmaps of weapon systems supporting Strategic Attack/Interdiction and Close Air Support mission areas.

***Strategic Attack (SA):*** SA is defined as those operations intended to directly achieve strategic effects. It is the intent of these operations to achieve their objectives without first having to engage the adversary's fielded military forces in extended operations at the operational and tactical levels of war. SA objectives often include producing effects to demoralize the enemy's leadership, military forces, and population, thus affecting an adversary's capability to continue the conflict. SA assets are composed of fighter (F-15E, F-16, F-117) and bomber (B-1, B-2, B-52) aircraft and their associated air-to-ground weapons.

***Interdiction:*** Interdiction consists of operations to divert, disrupt, delay, or destroy the enemy's surface military potential before it can be used effectively against friendly forces. Interdiction attacks enemy C<sup>2</sup> systems, personnel, materiel, logistics, and their supporting systems to weaken and disrupt the enemy's efforts and may have tactical, operational, or strategic effect. Fighter, bomber, surveillance, and battle management aircraft are employed to accomplish this mission.

***Close Air Support (CAS):*** CAS consists of air operations against hostile targets in close proximity or engaged with friendly forces and which require detailed integration of each air mission with the fire and movement of those forces. CAS provides direct support to help friendly surface forces carry out their assigned tasks. The A-10 and F-16 are the primary attack aircraft used to accomplish the CAS mission. ABCCC, Joint STARS, AWACS are the primary battle management and surveillance aircraft used to accomplish the CAS mission.

## ***ACC MAP Mission 4: Combat Search And Rescue***

The Combat Search and Rescue (CSAR) MAP provides a long-range modernization plan for the aircraft weapon systems that are responsible for conducting CSAR and other assigned missions. This MAP identifies tasks required to be accomplished by CSAR forces in support of theater and national military objectives. The primary operational task of CSAR forces is to recover downed aircrew members or other isolated personnel during war. Additionally, CSAR forces are tasked to perform rescue operations in military operations other than war (MOOTW). These MOOTW tasks include civil search and rescue (SAR), emergency aeromedical evacuation (MEDEVAC), disaster relief, international aid, noncombatant evacuation operations, counter-drug operations, and Space Shuttle support. CSAR forces responsible for accomplishing these tasks utilize the Sikorsky HH-60G Pave Hawk helicopter and Lockheed HC-130P/N Hercules.

## ***ACC MAP Mission 5: Surveillance and Reconnaissance***

The Surveillance and Reconnaissance (S&R) MAP combines two separate and complementary missions—surveillance and reconnaissance. This S&R MAP addresses critical areas of both with sometimes overlapping coverage. The first issue is collection; to include coverage quantity, the necessary level of detail, and data timeliness. Next is data processing, data exploitation and the appropriate dissemination. The third issue is communications. Items such as the creation of data links, selection of the proper data format and storage medium are of concern here. Fourth is survivability. What tactics are necessary for collection agent survivability and what is the appropriate defensive system to employ? Finally, is the S & R system reliable, maintainable and sustainable?

## ***Sources of Aircrew – System MOE/MOP Taxonomy***

In our search to obtain all available relevant Universal and Mission Essential Task Lists and the associated metrics, we examined the following documents:

- *Air Combat Command Strategic Plan* for FY 99 (1998)
- Air Force Doctrine Document (AFDD 1-1), *Air Force Task List* (1998)
- *Air Force Task List at the Tactical Level of War* (HQ USAF/XOOT, 1997)
- *Universal Joint Task List* (UJTL) (1996)
- *Universal Naval Task List* (UNTL) (1996)
- *Universal Army Task List* (UATL) (1996)
- *Air Education and Training Command Mission Essential Task List* (AETC METL, 1998)

In addition, we obtained and examined all relevant METLs and their related MOE/MOPs. However, as these were not fully developed, they were not utilized in the preparation of this section. These included:

- *2 AF Mission Essential Task List* (1998)
- *19 AF Mission Essential Task List* (1998)
- *14 Flying Training Wing (FTW) Mission Essential Task List* (1998)
- *47 Flying Training Wing (FTW) Mission Essential Task List* (1998)
- *56 Fighter Training Wing Mission Essential Task List* (1998)
- *71 Flying Training Wing (FTW) Mission Essential Task List* (1998)
- *81 Flying Training Wing (FTW) Mission Essential Task List* (1998)
- *97 AMW Mission Essential Task List* (1998)
- *189 Airlift Wing Mission Essential Task List* (1998)

We also obtained and examined available Air Force Instructions (AFI) pertaining to Aircrew Evaluation Criteria. A thorough review was done on the four asterisked items (\*) listed below.

- AFI 11-202, Volume 2, *Aircrew Standardization/Evaluation Program* (May 1998)
- \*AFI 11-2A/OA-10, Volume 2, *A/OA-10 Aircrew Evaluation Criteria* (July 1998)
- AFI 11-2B-52, Volume 2, *B-52 Aircrew Evaluation Criteria* (July 1998)
- MCI 11-C-130, Volume 2, *C-130 Aircrew Evaluation Criteria* (Jan 1997)
- AFI 11-2E-4, Volume 2, *E-4 Aircrew Evaluation Criteria* (July 1998)
- \*AFI 11-2F-15C, Volume 2, *Aircrew Evaluation Criteria* (Draft)
- \*AFI 11-2F-15E, Volume 2, *Aircrew Evaluation Criteria* (Draft)
- AFI 11-2F-16, Volume 1, *F-16 Aircrew Evaluation Criteria* (May 1998)
- \*AFI 11-2F-16, Volume 2, *F-16 Aircrew Evaluation Criteria* (May 1998)
- AFI 11-2HC-130, Volume 1, *HC-130 Aircrew Training* (July 1998)
- AFI 11-2HH-60, Volume 2, *HH-60 Aircrew Evaluation Criteria* (July 1998)
- AFI 11-2KC-10, Volume 1, *KC-10 Aircrew Training* (July 1998)
- AFI 11-2RC-135, Volume 2, *RC/OC/WC/TC-135 Aircrew Evaluation Criteria* (July 1998)
- AFI 11-2RQ-1, Volume 2, *RQ-1 Aircrew Evaluation Criteria* (July 1998)
- AFI 11-2T-38, Volume 2, *T-38 and AT-38 Aircrew Evaluation Criteria* (May 1998)
- AFI 11-2U-2, Volume 1, *U-2 Aircrew Training* (July 1998)

From information reviewed, the AFIs/MCIs appear to contain the most comprehensive evaluation criteria in use today. Given the lack of available METLs, MOE/MOPs, and criteria, we relied heavily on the AFTL and the four above asterisked AFIs for aircrew evaluation (measurement) criteria to update the information in the 1996 taxonomy. Also we reviewed the following ACC MAPs for the update.

1. Air Superiority
  - Counter Air
  - Theater Missile Defense (TMD)
  - Suppression of Enemy Air Defenses (SEAD)

2. Global Attack
  - Strategic Attack
  - Interdiction
  - Close Air Support (CAS)
3. Combat Search and Rescue
4. Surveillance and Reconnaissance

The 1996 version of the taxonomy (Best, Gentner, Cunningham, Schopper, & Morris, 1997) used the following additional sources. Items from these sources still appear in the present revision.

- Military Standard (MIL-STD) 1776A, *Aircrew Station and Passenger Accommodations* (DoD, 1994).
- Acquisition Documents, such as the Mission Need Statements (MNSs) and Operational Requirements Documents (ORDs), including the Requirements Correlation Matrix (RCM).
- Test and Evaluation Master Plans (TEMP) and Test Reports.
- Readiness Reporting Documents assisted AF Policy Directive (AFPD) 10-2, *Readiness* (1993), such as the *Status of Resources and Training System (SORTS) reporting readiness in these areas*: (1) personnel, (2) equipment on hand, (3) training, and (4) equipment condition.
- Operational Readiness Inspections (ORIs) are required in AFI 90-201, *Inspector General Activities* (AFI 90-201, 1997), which describes the subjects that to be covered during ORIs. Air Combat Command (ACC), Inspector General (AFI 90-201/ACC SUP 1, 1996), published a supplement to this AFI that details specific objective grading criteria.
- Military Exercises, both the AF and the Joint Chiefs of Staff conduct exercises to ensure the force is ready to perform a variety of missions and contingency actions. Exercises use real aircraft and simulated combat situations to test readiness and train war-fighting ability. *Blue* and *Red Flag* are examples of highly visible exercises; however, exercises are numerous and most are classified.
- Wargames and Simulations involve replicating warfare without actual combat, often involving computer simulations. Distributed simulation technology is now integrated into many exercises, competitions, and training programs.
- Military Competitions are scheduled every year to determine top honors in various mission areas. Competitions appear to be one of the more interesting sources of MOEs/MOPs. For example, ACC's *William Tell* combines competitions for pilot and weapons director accuracy, munitions loading speed and safety, and aircraft maintenance proficiency. Other examples of competitions include the ACC-sponsored combined force competitions, *Gunsmoke*, and combined mid- and long-range bombing competitions, *Long Shot*, and AMC's transportation tanker and airlift *Rodeo*.

## **Limitations**

Due to limited source availability, preparation times, and budgetary constraints, this taxonomy is not a complete treatise of all aircrew tasks and metrics. We selected four AFIs from the tactical arena – the A/OA-10, F-16, F-15C, and F-15E – as representative of what could be developed given additional research time. Consequently significant mission areas and consequential missions are not detailed in the *Aircrew-System Taxonomy* presented in Appendix G.

To complete the Aircrew-Systems Taxonomy, we envision a significantly expanded follow-up version of this report could be developed, following the same format but including greater depth and detail. In some mission areas (such as air refueling) we would plan to expand coverage (for the KC-10 airframe). In other cases we would cover currently unaddressed missions and measures (such as strategic bombing using B-52 tasking and measures and tactical airlift using C-130 tasks and measures). As more and more AFIs become available, we plan to expand coverage to those airframes as well (the F-117, for example). Our goal would be to address all aircraft expected in the emerging Air Expeditionary Force (AEF). Because the focus

of this report is to examine and highlight aircrew-specific taskings and measures, all non-aircrew specific taskings and/or measures (such as the three recurring AFTL items *Educate and Train Forces*, *Equip Forces* and *Plan Function*) have been deliberately omitted from this taxonomy.

### **Taxonomy Layout**

A representative excerpted portion of the complete Aircrew-System MOE/MOP Taxonomy (the complete taxonomy is located in Appendix G) is presented in Table 15. The title, Aircrew-System MOE/MOP Taxonomy, was selected to emphasize the high degree of interdependence between the human operator and the system. With today's complex technology and highly skilled aircrew, one cannot measure performance of one without considering the effect of the other.

**TABLE 15. Aircrew-System MOE/MOP Taxonomy (Sample).**

<b>Aircrew - System Performance</b>				
<b>8.4</b>	<b><i>Air-to-Ground Gunnery Events and Measure (No comparable AFT, AFI 11-2F-16 and AFI 11-2A/OA-10)</i></b>			
<b>Number</b>	<b>MOE/MOP</b>	<b>Definition (if needed)</b>	<b>Criteria (If available)</b>	<b>AFT # (If applicable) &amp; Reference</b>
M 8.4.5	<b>Loft Event</b>	A low altitude climbing delivery using appropriate aircraft systems for target acquisition, tracking, and weapons release while maximizing standoff range or weapons effects.	Hit criteria: 750 feet (229m).	AFI 11-2F-16, Volume 1, 1998
M 8.4.6	<b>Visual Level</b>	A delivery with less than five degrees of climb or dive at weapons release (non-maneuvering) using any means of delivery with visual target acquisition/designation	Hit criteria: 130 feet (40m).	AFI 11-2F-16, Volume 1, 1998
M 8.4.7	<b>Systems Level</b>	A delivery with less than five degrees of climb or dive at weapons release (non-maneuvering) using any means of delivery without visual target acquisition/designation	Hit criteria: 195 feet (60m).	AFI 11-2F-16, Volume 1, 1998
M 8.4.8	<b>Low Angle High Drag (LAHD)</b>	A dive angle of less than 30 degrees employing retarded weapons	Hit criteria: 75 feet (23m) for computed deliveries; 105 feet (32m) for manual; or within the target area or impacting the vertical panel in the skip target	AFI 11-2F-16, Volume 1, 1998

The taxonomy is organized with the task area title capitalized, along with its associated AFT number (if applicable). Each measure is given a unique identifying number in column 1, *Number* (see above). Column 2, *MOP/MOE* is the name of the measure. Column 3, *Definition*, is used only if clarification is required. Column 4, *Criteria*, is used only when specific, quantifiable criteria have been identified for that measure. Column 5, *AFTL # & Reference*, indicates the specific AFT source (if applicable) and the reference for the MOP/MOE.

## SUMMARY AND CONCLUSIONS

### Summary

This three-year project, consisting of two initial phases and a follow-on study, explored the nature and existence of warfighting MOEs/MOPs. This report is devoted to a review of the processes, procedures, MOEs, and MOPs used by MAJCOM commanders, evaluators, and other units to enhance and/or assess mission effectiveness. It explains procedures used to develop the first attempt to construct a comprehensive taxonomy of aeronautical warfighting MOEs/MOPs illustrating their hierarchical relationship. This section summarizes the steps taken in the study and highlights significant findings.

#### ***Literature Search and Initial Findings (Phase I)***

To determine the existence of a comprehensive listing of aeronautical warfighting MOEs/MOPs, CSERIAC-UDRI conducted an extensive search of the scientific and technical literature by examining Government and commercial databases, and the Internet. In addition, extensive networking with DoD personnel was necessary to obtain needed official documents and briefings, not available through the DTIC system.

When this study began, no comprehensive list of DoD MOEs/MOPs could be found. MOEs/MOPs were not well documented in the literature, except in COEAs and T&E Reports, which are often *Limited Distribution* or *Classified* documents. MOEs/MOPs must often be inferred or derived from the various metrics used by commanders and high-level decision-makers in inspections, briefings, and evaluations. After our initial search was completed, we discovered one new source of MOEs/MOPs – the emerging effort to document Joint and mission essential tasks in the Universal Joint Task List (UJTL, 1996). Initially the UJTL effort had only a few aeronautically oriented MOEs/MOPs. We, therefore, furnished copies of our initial listing of the *Aeronautical System - Human Performance MOE/MOP Taxonomy* to these Joint and related Service-specific efforts for inclusion with their mission essential task lists.

#### ***Constructing the Aeronautical System – Human Performance MOE/MOP Taxonomy and Hierarchy***

In constructing the taxonomy, we identified a number of sources from which we identified or derived warfighting MOEs/MOPs. Initially we had great expectations for SORTS, since it is the primary unit readiness reporting system; however, this system was found to be of only limited value. SORTS was devised to identify the current level of selected resources and training status of a unit—that is, its ability to undertake its wartime mission. The GAO found that SORTS “does not capture all the factors that DoD considers critical to a comprehensive readiness analysis” (GAO/NSIAD-96-111BR, 1996; GAO/NSIAD-96-194, 1996, Snyder, 1995). SORTS provided only a few generic measures of readiness that we could use in the taxonomy.

Excellent sources of MOEs/MOPs are provided by OT&E and ORI reports. An OT&E MOE is a measure of a system’s mission task accomplishment and, according to AFOTEC, should be developed to a level of specificity permitting a system’s effectiveness to be evaluated consistent with the COEA (AFOTEC/XRX, 1995). The IG conducts ORIs for the MAJCOM commander to evaluate the operational readiness of units with wartime missions (AFI 90-201, 1996; AFI 90-201, 1997). MAJCOMs publish their general evaluation criteria, and ACC provides detailed listings of its ORI criteria that provided excellent sources for additional MOEs/MOPs.

Additional sources of MOEs/MOPs were identified. For example, military exercise programs, wargames and simulations, and competitions provide commanders and high-level decision-makers information on the warfighting capability of their commands. Scoring criteria are commonly based on MOEs/MOPs or surrogate measures accepted by commanders as predictive indicators of combat readiness. Although several examples of each were provided in this report, exercises, wargames, and

competitions are numerous and many of the exercises are classified. Therefore, our coverage was representative, but not comprehensive.

Command briefings (e.g., “Health of the Force” [monthly] briefings) are also excellent indicators in pinpointing significant MOEs/MOPs considered most important to commanders, evaluators, and staff. By graphically depicting how well a unit meets the expected MOE, these briefings allow the commander and key staff to monitor how well MAJCOM units meet the specified MOEs/MOPs in relation to set standard performance levels (AMC/LGQP, 1996). These command briefings focused on system readiness measures and repair ratios.

In summary, we used the following sources to initially develop (in Phase I) the *Aeronautical Human-System Performance MOE/MOP Taxonomy*, and later used them to refine the taxonomy in Phase II and the follow-on study:

- Exercises
- Wargames/Simulations
- Military Competitions
- Operational Test and Evaluation
- Operational Readiness Inspection Criteria
- Command Briefings
- MIL-STDs and Regulations/Instructions
- Mission Area Analyses and Mission Area Plans
- Acquisition Documents
- Readiness Reporting Systems
- Joint and Service Mission Essential Task List efforts
- Related Surrogate Measures

### **Phase II Tasks**

In the second phase of this research, we identified, collected, and reviewed official documents that indicated MAJCOMs preferred MOEs/MOPs and the priority placed upon them. The focus of the initial part of Phase II was on aircraft maintenance, since performance data is continually collected and results are briefed at the highest MAJCOM levels in the “Health of the Force” briefings. In addition, we refined the MOEs/MOPs taxonomy showing hierarchical relationships of the criteria of war-fighting capability through. Specifically, we reviewed limited distribution documents (though no classified documents were examined) to assist in developing hierarchical listings of AF MOEs. Next we expanded the list of MOEs/MOPs to include late-arriving documents requested from AF and other sources. Then, we reviewed the MAAs and deficiencies documented in MAPs to identify current issues that could be linked with human performance metrics.

### **Follow-on Study Tasks**

In a follow-on study, UDRI expanded coverage of Aircrew MOEs/MOPs, separating this portion of the taxonomy from the system and maintenance portions. The focus of this effort was to identify aircrew metrics that could be used in the DMT environment. Consequently, we selected the A/OA-10, F-16, F-15C, and F-15E since these fighter aircraft seemed to have more immediate application. To complete the aircrew taxonomy, more research time and funding will be necessary to cover all aircraft.

## **Conclusions**

As a result of this extended study, the *Aeronautical System – Human Performance MOE/MOPs Taxonomy* for aircrew and maintainers now is available for use. In addition, procedures and techniques have been developed to collect and place emerging MOE/MOPs into the taxonomy as they become available. The taxonomy provides in one location, the most comprehensive listing of warfighting

MOEs/MOPs for aeronautical systems collected to date. These MOEs/MOPs can now be more easily used to improve the *Air Force Task List* (1998), to evaluate units and exercises, and ultimately to evaluate R&D products, such as Distributed Mission Training systems. In summary, the following items highlight the major conclusions of this research.

**Conclusion 1: MOEs/MOPs Numerous and Not Well Documented in Literature**

While there is a limited set of AF missions, and mission tasks and subtasks, AF MOEs and MOPs are as numerous as the organizations assigned to fulfill those missions. A major finding of this literature search is that because of the tremendous variety, evolving nature, and sheer number of MOEs/MOPs, a comprehensive listing does not exist in the literature. Further, MOEs/MOPs are not well documented in the open literature and must be ferreted out of many documents or developed by inference. However, at the time of this report's development, there was renewed interest in documenting and using MOEs/MOPs in Air Force mission analysis, and in 1998, the AFTL published a consolidated listing of mission tasks and related MOE/MOPs.

**Conclusion 2: Aircraft Maintenance Versus Aircrew Taxonomies Differ**

The aircraft maintenance taxonomy can be hierarchically based because most metrics have a mathematical or implied relationship to higher- and lower-level MOEs/MOPs. The Aircrew taxonomy differs from maintenance taxonomy because it has a mission focus—it is subdivided by mission area, while the maintenance taxonomy clearly relates to a single mission – sortie production, which is part of AF Task 6, Agile Combat Support.

**Conclusion 3: Aircraft Maintenance Hierarchical Structure Could Support Modeling**

In the maintenance area, the MOEs/MOPs were being used independently, without consideration or linking to their effect on the overall operational capability. The Maintenance MOE hierarchy illustrates the possible mathematical relationships and linkages. This hierarchy structure could possibly be built into simulation models, allowing mission impacts to be derived from changes in maintenance activities.

**Conclusion 4: Aircrew Taxonomy Needs Additional Research**

The Aircrew-System MOE/MOP Taxonomy needs additional work to cover all Air Force missions and aircraft. Because of time and budgetary constraints, the development of the Aircrew-Systems MOE/MOP Taxonomy was primarily based on a detailed review of only four fighter aircraft for a limited number of missions. However, across these four aircraft, there was a high level of commonality. To cover all aircraft in a uniform fashion, the taxonomy needs to consider all other Air Force missions and aircraft in equal detail.

**Conclusion 5: MOE/MOP Taxonomy Available for Application to Evaluate Mission-Oriented Training**

Now that the *Aeronautical System - Human Performance MOE/MOP Taxonomy* is relatively comprehensive and available for use, it can be applied to evaluate mission-oriented training. By using the MOEs/MOPs that MAJCOM decision-makers and evaluators value as well as the more detailed MOPs derived from official documents, training systems and technology can be more closely aligned with the needs of the warfighter.

## **RECOMMENDATIONS**

While the *Maintenance-System MOE/MOP Taxonomy* is ready for use, some additional work is needed on the *Aircrew-System MOE/MOP Taxonomy* to ensure it can be applied across all needed aircraft. To gain the maximum benefit from this research, methods to employ the taxonomies need to be developed and tested. To refine these procedures, they must be applied in operational evaluations of

training and other systems. The DMT system might be an excellent testbed in which to apply this operationally-based training evaluation techniques. Explanations for these recommendations are furnished below.

### ***Further Development of Aircrew Taxonomy Needed***

Development time and resources were only available for the *Aircrew-System MOE/MOP Taxonomy* to focus on a limited number of missions for only four aircraft, the A-10, F-16C, F-15C, and F-15E. To complete the aircrew taxonomy, additional aircraft and missions must be examined and this taxonomy refined. We suggest expanding the aircraft and missions on a priority basis to cover anticipated DMT systems. A reasonable goal might be to concentrate on all AEF aircraft.

**Application of Taxonomy Should Proceed.** To work out procedures for the taxonomy's use, it should be applied in an operationally oriented training system program. Application should have several goals: (a) determine if all essential MOEs/MOPs are, indeed, captured in the taxonomy; (2) determine the best organization of the taxonomy to assist in performing the operational evaluation; (3) test, refine, and document procedures for using the taxonomy in operational evaluations; (4) determine other applications for the taxonomy.

### ***Possible Testbeds***

One specific area for use and testing of the taxonomy would be to evaluate the effectiveness of operationally oriented training. By using warfighting metrics important to MAJCOM commanders, evaluators, and other higher-level decision makers, trainers can be more assured that their training systems and curricula are adequately preparing the warfighter. Linking higher level mission-oriented MOEs/MOPs with more specific metrics can help visualize how changes that affect lower level MOPs affect higher, mission-essential MOEs. Thus, the organizational and mission payoffs can be more clearly determined. Specifically, the DMT program might be an effective place to test, refine, and develop operational procedures for using the MOE/MOP taxonomy. More than any past aircrew training system, the emerging DMT program needs operational evaluation. Since the system's stated mission is to train mission tasks, rather than the mechanics of flying, DMT needs to be evaluated with mission effectiveness metrics. In addition, the taxonomy could be tested during mission development for the emerging AEF, and perhaps in the Air Force battle laboratories.

## REFERENCES

- 2nd Air Force. (1998). *2 AF Mission Essential Task List*.
- 14 Flying Training Wing. (1998). *14 Flying Training Wing (FTW) Mission Essential Task List*.
- 19th Air Force (1998). *19 AF Mission Essential Task List*.
- 47 Flying Training Wing. (1998). *47 Flying Training Wing (FTW) Mission Essential Task List*.
- 56 Fighter Training Wing. (1998). *56 Fighter Training Wing Mission Essential Task List*.
- 71 Flying Training Wing. (1998). *71 Flying Training Wing (FTW) Mission Essential Task List*.
- 81 Flying Training Wing. (1998). *81 Flying Training Wing (FTW) Mission Essential Task List*.
- 97 AMW. (1998). *97 AMW Mission Essential Task List*.
- 189 Airlift Wing. (1998). *189 Airlift Wing Mission Essential Task List*.
- ACC (ACC/DOOO). (1996). *Official rules - William Tell 1996, 7 Aug 96*. Langley AFB, VA: Author.
- ACC (ACC/DR). (1996). *Mission area plans*. Langley AFB, V A: Directorate of Requirements: Author. [Online]. Available: <http://nt2.dr.langley.af.mil/map01.html>
- ACC (ACC/DR). (1998). *Mission area plans*. Langley AFB, V A: Directorate of Requirements: Author. [Online]. Available: <http://nt2.dr.langley.af.mil/map01.html>
- ACC (ACC/DRS). (1995a). *Air Force modernization planning: Combat delivery mission area plan FY1996, 15 Nov 95*. Langley AFB, VA: Author.
- ACC (ACC/DRS). (1995b). *Air Force modernization planning: Combat rescue mission area plan FY1996, 15 Nov 95*. Langley AFB, VA: Author.
- ACC. (1998). *Air Combat Command Strategic Plan for FY 99*. Langley AFB, VA: Author.
- AETC. (1996a). *2025: Executive summary*. Maxwell AFB, AL: 2025 Support Office, Air University: Author.
- AETC. (1996b). AETC missions. AETC Magazine Online. Randolph AFB, TX: Author. [Online]. Available: <http://cag.aetc.af.mil/Aetcmag/Aetcmag.htm>
- AETC. (1998). *Air Education and Training Command Mission Essential Task List (AETC METL)*. Randolph AFB, TX: Author.
- AFDD 1-1, *Air Force Doctrine Document, Air Force Task List*. (1998). Washington, DC: AFDC (AFDC/XD).
- AFDD 35, Special operations. (1995). Washington, DC: AFDC (AFDC/XD).
- AFFWC (AFFWC/PA). (1992). *Red Flag*. Nellis AFB, NV: Directorate of Public Affairs: Author. [Online]. Available: <ftp://ftp.primenet.com/users/c/cdaleb/Briefings/RedFlag.txt>
- AFI 10-201, *Status of resources and training system*. (1995). Washington, DC: USAF (USAF/XOOOR).
- AFI 10-602, *Determining logistics support and readiness requirements*. (1994). Washington, DC: USAF (USAF/LGMM).
- AFI 10-1401, *Modernization planning documentation*. (1995). Washington, DC: USAF (USAF/XOFP).
- AFI 11-2A/OA-10, Volume 2, *Flying Operations, A/OA-10 Aircrew Evaluation Criteria*. (1998). Langley AFB, VA: ACC.
- AFI 11-202, Volume 2, *Flying Operations, Aircrew Standardization/Evaluation Program*, (1998). Langley AFB, VA: ACC.
- AFI 11-2B-52, Volume 2, *Flying Operations, B-52 Aircrew Evaluation Criteria*. (1998). Langley AFB, VA: ACC.
- AFI 11-2E-4, Volume 2, *Flying Operations, E-4 Aircrew Evaluation Criteria*. (1998). Langley AFB, VA: ACC.

AFI 11-2F-16, Volume 1, *Flying Operations, F-16 Aircrew Training*. (1998). Langley AFB, VA: ACC.

AFI 11-2F-16, Volume 2, *Flying Operations, F-16 Aircrew Evaluation Criteria*. (1998). Langley AFB, VA: ACC.

AFI 11-2HC-130, Volume 1, *Flying Operations, HC-130 Aircrew Training Program*. (1998). Langley AFB, VA: ACC.

AFI 11-2HH-60, Volume 2, *Flying Operations, HH-60 Aircrew Evaluation Criteria*. (1998). Langley AFB, VA: ACC.

AFI 11-2KC-10, Volume 1, *Flying Operations, KC-10 Aircrew Training*. (1998). Langley AFB, VA: ACC.

AFI 11-2RC-135, Volume 2, *Flying Operations, RC/OC/WC/TC-135 Aircrew Evaluation Criteria*. (1998). Langley AFB, VA: ACC.

AFI 11-2RQ-1, Volume 2, *Flying Operations, RQ-1 Aircrew Evaluation Criteria*. (1998). Langley AFB, VA: ACC.

AFI 11-2T-38, Volume 2, *Flying Operations, T-38 and AT-38 Aircrew Evaluation Criteria*. (1998). Langley AFB, VA: ACC.

AFI 11-2U-2, Volume 1, *U-2 Aircrew Training*. (1998). Langley AFB, VA: ACC.

AFI 21-101, *Maintenance management of aircraft*. (1996). Washington, DC: USAF (USAF/LGMM).

AFI 36-401, *Employee training and development*. (1994). Washington, DC: USAF (USAF/DPP).

AFI 90-201, *Inspector General activities*. (1997). Washington, DC: SAF (SAF/IGI).

AFI 90-201/ACC SUP 1, *Inspector General activities*. (1996). Langley AFB, VA: ACC (ACC/IGIX).

AFI 90-201/AFSOC SUP 1, *Inspector General*. (1995). Hurlburt Field, FL: AFSOC (AFSOC/IG).

AFI 99-102, *Operational test and evaluation*. (1994). Kirtland AFB, NM: AFOTEC (AFOTEC/XRX).

AFI 99-103, *Test and evaluation process*. (1994). Washington, DC: USAF (USAF/TEP).

AFMD 14, *Air Force Operational Test and Evaluation Center*. (1996). Washington, DC: USAF (USAF/TEP).

AFNS. (1995a). *Bright Star 95 under way*. [Online]. Available: <http://www.dtic.mil/cgi-bin/waisgate?WAISconnType=&WAISdocID=154744015+12+0+0&WAISaction=retrieve>

AFNS. (1995b). *Cope North to kick off*. [Online]. Available: <http://www.dtic.mil/cgi-bin/waisgate?WAISconnType=&WAISdocID=154744015+18+0+0&WAISaction=retrieve>

AFNS. (1995c). *Blue Flag set in Caribbean*. [Online]. Available: <http://www.dtic.mil/cgi-bin/waisgate?WAISdocID=7932927811+23+0+0&WAISaction=retrieve>

AFNS. (1996a). *SECAF cites importance of Blue Flag*. [Online]. Available: <http://www.dtic.mil/cgi-bin/waisgate?WAISconnType=&WAISdocID=154744015+21+0+0&WAISaction=retrieve>

AFNS. (1996b). *Long Shot announced*. [Online]. Available: <http://www.dtic.mil/cgi-bin/waisgate?WAISdocID=7188124855+41+0+0&WAISaction=retrieve>

AFOTEC (AFOTEC/XRC). (1991). *C-17 initial operational test and evaluation (IOT&E) Plan*. Kirtland AFB, NM: Author.

AFOTEC (AFOTEC/XRC). (1994). *V-22 operational assessment plan*. Kirtland AFB, NM: Author.

AFOTEC (AFOTEC/XRC). (1996). *B1-B (BLK D) conventional mission upgrade program (CMUP) operational assessment plan*. Kirtland AFB, NM: Author.

AFOTECH 99-101, *Test concept handbook*. (1995). Kirtland AFB, NM: AFOTEC (AFOTEC/XRC).

AFOTECI 99-101, *Management of operational test and evaluation*. (1995). Kirtland AFB, NM: AFOTEC (AFOTEC/XRX).

AFPD 10-2, *Readiness*. (1997). Washington, DC: USAF (USAF/XOOO).

- AFPD 10-14, *Modernization planning*. (1995). Washington, DC: USAF (USAF/XOME).
- AFPD 90-2, *Inspector General - The inspection system*. (1996). Washington, DC: SAF (SAF/IGI).
- AFPD 99-1, *Test and evaluation process*. (1993). Washington, DC: USAF (USAF/TEP).
- Airman Magazine* (1998). Air National Guard. [On-line]. Available: <http://www.af.mil/news/airman/0198/ang.htm>
- AMC (1998). *AMC Mission*. [On-line]. Available: <http://www.safb.af.mil/hqamc/mission.htm>
- AMC (AMC/LGQP). (1996). *Health of the force briefing*. Scott AFB, IL: Author. [Online]. Available: <http://amclg.safb.af.mil/lgmain.html>
- AMC (AMC/PA). (1996). *RODEO '96*. Scott AFB, IL: Author. [Online]. Available: <http://www.safb.af.mil/hqamc/pa/rodeo1/whatis.htm>
- AMC (AMC/XP) (1995). *1996 Air Mobility master plan (AMMP-96)*, 2 Oct 95. Scott AFB, IL: Author.
- AMC (AMC/XP) (1996). *1997 Air Mobility master plan (AMMP-97)*, 11 Oct 96. Scott AFB, IL: Author.
- AMCI 90-201, *The inspection system*, (1996). Scott AFB, IL: AMC (AMC/IGPS).
- AMCPAM 21-102, *Unit health of the force reports and maintenance analysis guide*. (1995). Scott AFB, IL: AMC (AMC/LGQA).
- ANGRC (ANGRC/XO). (1996). *Global Yankee' 96*. Washington, DC: Author. [Online]. Available: <http://www.ang.af.mil/angrc-xo/glbynk/glbynk.htm>
- Battilega, J.A. & Grange, J.K. (eds.) (1984). *The choices and uses of criteria*. The military applications of modeling. Wright-Patterson AFB, OH: Air Force Institute of Technology (AFIT) Press, 38-62.
- Best, P. S., Gentner, F. C., Cunningham, P. H., Schopper, A.W., & Morris, J.D. (1997). *Evaluating warfighter (aircrew and maintainers) performance in aeronautical systems using Measures of Effectiveness*. Wright-Patterson AFB, OH: Crew System Ergonomics Information Analysis Center (CSERIAC).
- Boyle, E. (1990). *LCOM explained*. (AFHRL-TP-90-58, AD A224 997). Wright-Patterson AFB, OH: Logistics and Human Factors Division.
- Bradford, D., Brett, E., & Phelps, D. (1995). *DIS compatible mission planning for improved rehearsal and training effectiveness*. Interservice/Industry Training Systems and Education Conference (I/ITSEC) Proceedings and Exhibits. 13-16 Nov 96, Arlington, VA: American Defense Preparedness Association.
- Chairman of Joint Chiefs of Staff Manual. (1996). Section 3: *Conditions for Joint Tasks*. Department of Defense, Pentagon, Washington, D.C.
- CJCSM 3500.04A (1996). *Universal Joint Task List (UJTL)*. Wash, DC: Chairman Joint Chief of Staff.
- CJCSM 3500.04A (Draft 1998). *Universal Joint Task List (UJTL)*. Washington, DC: Chairman Joint Chief of Staff.
- Clark, G. (1989). LCOM: An analysis tool for MPT. *IMPACTS Bulletin*, 1(2). Wash, DC: HQ USAF.
- Conwell, C. L. (1995). *Joint warfare simulation object library: Joint warfare taxonomy* (Technical Document 2808, AD A303 486). San Diego, CA: Naval Command, Control and Ocean Surveillance Center.
- Cooper, S. (1996). *JAST logistics modeling environment: MPT DSS*. Briefing presentation material. Presented 26 Jan 96.
- Correll, J.T. (Ed.) (1996, May). Records, trophies, and competitions. *Air Force Magazine*, 79(5). Arlington, VA: The Air Force Association. Pp 21-129.
- Dalrymple, M. (1996). Measuring situational awareness in the AESOP's AWACS WD simulator. (Abstract and presentation material). *Proceedings of the First Annual Symposium on Situational*

- Awareness in the Tactical Air Environment*. Patuxent River MD: Naval Air Warfare Center - Aircraft Division.
- DoD Directive 5000.1, *Defense acquisition*. (1996a). Washington, DC: Author.
- Dudley, J.R., & Novotny, M.J. (1994). *A methodology for establishing maximum aircraft combat turn rates* (Thesis). Wright-Patterson AFB, OH: AFIT. (DTIC No. AD-A285 000)
- Eisenhardt, R.G., Eisenhardt, G.H., & Douthat, D.Z. (1985). *Pilot's associate definition study*. Arlington, VA: Defense Advanced Research Projects Agency. (DTIC No. AD-A157 106)
- Federico, P.A., Ullrich, R.R., Van de Wetering, B.L., Tomlinson, C.I., & Long, D.J. (1991). *Human-computer interfaces for tactical decision-making, analysis, and assessment using artificially intelligent platforms: Volume 1, software design and database descriptions for BATMAN & ROBIN* (NPRDC TN 91-20, AD A241 509). San Diego, CA: Navy Personnel Research and Development Center.
- GAO/NSIAD-96-105 (1996). *Military readiness: A clear policy is needed to guide management of frequently deployed units*. Washington, DC: Author.
- GAO/NSIAD-96-111BR (1996). *Military readiness: Data and trends for January 1990 to March 1995*, Washington, DC: Author.
- GAO/NSIAD-96-170 (1996). *Bottom-up review: Analysis of DOD war game to test key assumptions*. Washington, DC: Author.
- GAO/NSIAD-96-194 (1996). *Military readiness: Data and trends for April 1995 to March 1996*. Washington, DC: Author.
- GAO/T-NSIAD-97-107 (1997). *Military Readiness: Improvements still needed in assessing military readiness*. Washington, DC: Author.
- Gillis, P.F. (1996). Joint readiness automated management system (JRAMS). (Abstract and presentation material). *Proceedings of the Military Operations Research Society (MORS) Symposium: Leveraging Technology for the Military Analyst*. 18-20 Jun 96. Ft. Leavenworth, KS: US Army Combined Arms Center.
- Goehring, S. (1993). *An analysis of the ability of commercial wargames to fulfill the education requirements of the air force wargaming center* (Thesis). Wright-Patterson AFB, OH: AFIT. (DTIC No. AD-A262 488)
- Gould, B. (1995). *Criteria for evaluating human systems technology effects on war-fighting capabilities*. Brooks AFB, TX: Armstrong Laboratory/Human Resources Directorate (AL/HRT).
- GUNSMOKE history*. (1995). [Online]. Available: <ftp://ftp.primenet.com/users/c/cdaleb/Briefings/Gunsmoke.txt>
- Hiller, J.H. (1994). Deriving useful lessons from combat simulations. In Holz, R.F., Hiller, J.H., & McFann, H.H. (eds.). *Determinants of effective unit performance: Research on measuring and managing unit training readiness*. Alexandria, VA: US Army Research Institute for the Behavioral and Social Sciences. (DTIC No. AD-A292 342)
- Johnson, R. (1996). Bombs away: Exercise links aircrews, ammo troops to put bombs on target. *Airman*, July 1996. Washington, D.C., Department of the Air Force.
- JAST. (1995). *JAST operations analysis study plan: Revision 1*. April 1995: Author.
- Junor, L.J., & Oi, J.S. (1996). *A new approach to modeling ship readiness* (CRM 95-239). Alexandria, VA: Center for Naval Analyses.
- Kabaneck, K.W. (1991). *An automated red player for the theater warfare exercise* (Thesis). Wright-Patterson AFB, OH: AFIT. (DTIC No. AD-A238 737)
- Kennard, C.W. (1996). NavalCAT - A readiness and commander's assessment tool. (Abstract and presentation material). In *Proceedings of the Military Operations Research Society (MORS)*

- Symposium, Leveraging Technology for the Military Analyst.* 18-20 Jun 96. Ft. Leavenworth, KS: US Army Combined Arms Center.
- Koestler, A. (1979). *Janus: A summing up.* New York: Vintage Books.
- Lane, N.E. (1986). *Issues in performance measurement for military aviation with application to air combat maneuvering* (NTSC TR-86-008). Orlando, FL: Essex Corporation.
- MCI 11-C-130, Vol 2, *Flying Operations, C-130 Aircrew Evaluation Criteria* (1998). Langley AFB, VA: ACC.
- McKenzie, T. (1996). *Modernization planning process.* (Presentation material) Presented at the ACC Modernization Planning Process Cost Conference, 6-7 Aug 96. Langley AFB, VA: HQ ACC.
- Medlock, K.V.T. (1996). The readiness baseline. (Abstract and presentation material). *Proceedings of the Military Operations Research Society (MORS) Symposium: Leveraging Technology for the Military Analyst.* 18-20 Jun 96. Ft. Leavenworth, KS: US Army Combined Arms Center.
- Miller, N. (1996). *AMOG express cuts deployment time in half.* Scott AFB, IL: AMC News Service (AMCNS) News Release, 9 Sep 96; Office of Public Affairs. [Online]. Available: <http://www.safb.af.mil/hqamc/pa/news/september/960905.htm>
- MIL-STD 1776A. (1994). Military Standard. *Aircrew station and passenger accommodations.* Washington, DC: Author.
- Naval Tactical Task List 2.0 (1996), *Universal Naval Task List (UNTL).* Washington, D.C.: Department of the Navy.
- Neal, P. (1996). Joint automated readiness system (JARS). (Abstract and presentation material). *Proceedings of the Military Operations Research Society (MORS) Symposium: Leveraging Technology for the Military Analyst.* (18-20 Jun 96.) Ft. Leavenworth, KS: US Army Combined Arms Center.
- OPNAVINST 3500.38, *Universal naval task list (UNTL)* - Section 5: Measures for joint and naval tasks. (1996). Manuscript in press.
- Orlansky, J., String, J., & Chatelier, P.R. (1982). *The cost-effectiveness of military training.* In The Proceedings of the 4<sup>th</sup> Interservice/Industry Training Equipment Conference, 16-18 Nov 82. Vol 1. (DTIC No. AD-P000 168)
- PACAF (PACAF/LGS). (No Date). *Logistics Metric Handbook.* Hickam AFB, HI: Author. [Online]. Available: <http://www.hqpacaf.af.mil/lgs/metrics.htm>
- Rusing, R.L. (1980). *Prepare the fighter force - Red Flag/composite Force (Thesis).* Ft. Leavenworth, KS: Army Command and General Staff College. (DTIC No. AD-A094 982)
- Snyder, D.M., Dieryck, P.J., Long, W.W., Philipkosky, T.G., & Reis, R. (1996). *Joint readiness assessment and planning integrated decision system (JRAPIDS): Combat readiness and joint force management for 2025.* Maxwell AFB, AL: AF2025 Support Office, Air University: Author.
- Snyder, T.J. (1995). *Contingency contracting deliberate planning handbook.* Maxwell AFB, AL: Air Force Logistics Management Agency/LGC. (DTIC No. AD-B196 850)
- SofTech, Inc. (1985). *Air Force integrated readiness measurement systems (AFIRMS): Analysis of military airlift command (MAC) capability assessment metrics.* Alexandria, VA: Author. (DTIC No. AD-A170 523)
- Survivability and Vulnerability Information Analysis Center (SURVIAC). (1994, Nov). Model spotlight: TAC BRAWLER. *SURVIAC Bulletin.* Wright-Patterson AFB, OH: Author.
- Universal Army Task List (UATL).* (1996). Washington, D.C.: Department of the Army.
- USAFE (USAFE/LGP). (1997). *USAFE/LG functional metrics,* 6 Jan 97. Author.

- USAF (USAF/XOXP). (1996). *Air Force modernization planning (AFMP)*. [Online]. Available: [http://www.hq.af.mil/XO/xoxp/hp\\_xoxp.htm](http://www.hq.af.mil/XO/xoxp/hp_xoxp.htm)
- USAF Fact Sheet, *Air Combat Command*. (1997a). [On-line]. Available: [http://www.af.mil/news/factsheets/Air\\_Combat\\_Command.html](http://www.af.mil/news/factsheets/Air_Combat_Command.html)
- USAF Fact Sheet, *Air Education and Training Command*. (1997b). [On-line]. Available: [http://www.af.mil/news/factsheets/Air\\_Education\\_and\\_Training\\_Co.html](http://www.af.mil/news/factsheets/Air_Education_and_Training_Co.html)
- USAF Fact Sheet, *Air Force Materiel Command*. (1997c). [On-line]. Available: [http://www.af.mil/news/factsheets/Air\\_Force\\_Materiel\\_Command.html](http://www.af.mil/news/factsheets/Air_Force_Materiel_Command.html)
- USAF Fact Sheet, *Air Force Reserve Command*. (1997d). [On-line]. Available: [http://www.af.mil/news/factsheets/Air\\_Force\\_Reserve\\_Command.html](http://www.af.mil/news/factsheets/Air_Force_Reserve_Command.html)
- USAF Fact Sheet, *Air Force Special Operations Command*. (1998). [On-line]. Available: [http://www.af.mil/news/factsheets/Air\\_Force\\_Special\\_Operations.html](http://www.af.mil/news/factsheets/Air_Force_Special_Operations.html)
- USAF Fact Sheet, *Air National Guard*. (1997). [On-line]. Available: [http://www.af.mil/news/factsheets/Air\\_National\\_Guard.html](http://www.af.mil/news/factsheets/Air_National_Guard.html)
- USAF Fact Sheet, *Organization of the United States Air Force*. (1997b). [On-line]. Available: [http://www.af.mil/news/factsheets/Organization\\_of\\_the\\_United\\_St.html](http://www.af.mil/news/factsheets/Organization_of_the_United_St.html)
- USAF Fact Sheet, *Pacific Air Forces*. (1998). [On-line]. Available: <http://www.hqpacaf.af.mil/facts/pacaf.htm>
- USAF Fact Sheet, *United States Air Forces in Europe*. (1997e). [On-line]. Available: [http://www.af.mil/news/factsheets/United\\_States\\_Air\\_Forces\\_in\\_E.html](http://www.af.mil/news/factsheets/United_States_Air_Forces_in_E.html)
- USNGB (USNGB). (1993). *The national guard: Defending the nation and the states*. (Document No. A-124). Washington, DC: Author. [Online]. Available: [http://www.dtic.mil:80/defense/links/guardlink/pubs/a\\_124/index.html](http://www.dtic.mil:80/defense/links/guardlink/pubs/a_124/index.html)
- USSOCOM. (1995). *Air Force Special Operations Command (AFSOC) weapons system roadmap*, Sep 95. Washington, DC: Author.
- Vidulich, M. (1994). Cognitive and performance components of situation awareness: SAINT team task one report. In Vidulich, M., Dominguez, C., Vogel, E., & McMillian, G. (Eds.), *Situation awareness: Papers and annotated bibliography*. (AL/CF-TR-1994-0085, 17-28). Wright-Patterson AFB, OH: Armstrong Laboratory, Crew Systems Directorate.
- Vidulich, M., Dominguez, C., Vogel, E., & McMillian, G. (Eds.) (1994). *Situation awareness: Papers and annotated bibliography*. (AL/CF-TR-1994-0085). Wright-Patterson AFB, OH: Armstrong Laboratory, Crew Systems Directorate.
- Vogel, E. (1994). SA: An operational point of view. In Vidulich, M., Dominguez, C., Vogel, E., & McMillian, G. (Eds.), *Situation awareness: Papers and annotated bibliography*. (AL/CF-TR-1994-0085, 17-28). Wright-Patterson AFB, OH: Armstrong Laboratory, Crew Systems Directorate.
- Wagner, M. (1996). Joint mission essential task lists (JMETL): A foundation for mission-based readiness assessment. (Abstract and presentation material). In *Proceedings of the Military Operations Research Society (MORS) Symposium: Leveraging Technology for the Military Analyst*. 18-20 Jun 96. Ft. Leavenworth, KS: US Army Combined Arms Center.
- Warrior Preparation Center (WPC). (1996). *CAX defined*. [Online]. Available: <http://www.wpc.af.mil/cax.html>

## **APPENDIX A, Points of Contact at MAJCOMs**

### ***Air Combat Command***

Office of Public Affairs (ACC/PA)  
115 Thompson St., Suite 211  
Langley AFB, VA 23665-1987  
DSN 574-5007 or (804) 764-5007  
e-mail: pan@hqaccpa.langley.af.mil

### ***Air Mobility Command***

Public Affairs Office (AMC/PA)  
502 Scott Drive  
Scott AFB, IL 6225-5317  
DSN 576-5003 or (618) 256-5003

### ***Air Force Special Operations Command***

Public Affairs Office (AFSOC/PA)  
100 Bartley St.  
Hurlburt Field, FL 32544-5273  
DSN 579-5515 or (904) 884-5515

### ***Air Education and Training Command***

Public Affairs Office (AETC/PA)  
100 H Street, Suite 3  
Randolph AFB, TX 78150-4330  
DSN 487-3946 or (210) 652-3946

### ***Air Force Materiel Command***

Public Affairs Office HQ AFMC/PA  
4375 Chidlaw Road, Suite 6  
Wright-Patterson AFB, OH 45433-5006  
DSN 787 7592 Or (937) 257-7592

### ***Air National Guard Bureau***

Office of Public Affairs  
2500 Army Pentagon  
Washington, D.C. 20310-2500  
DSN 225-0421 or (703) 695-0421

### ***Air Force Reserve Command***

Office of Public Affairs  
The Pentagon  
Washington, D.C. 20310-2500

### ***US Air Forces in Europe***

Public Affairs Office  
Unit 3050, Box 120; APO AE 09094-0120;  
DSN 480-6559 or  
(011) 49-6371-47-6559  
e-mail: usafepai@usafe25.ramstein.af.mil

### ***Pacific Air Forces***

Public Affairs Office  
25 E Street, Suite I-106  
Hickam AFB, HI 96853-5496  
DSN 449-2490 or (808) 449-2490

This page intentionally left blank.

## **APPENDIX B, Aircraft Maintenance – System MOE/MOP Taxonomy**

## **Aircraft Maintenance - Aeronautical System - Human Performance MOE/MOP Taxonomy**

**31 Aug 98**

P. Scot Best

Frank C. Gentner

Paul H. Cunningham

Jason D. Morris



AFRL/HEC/CSERIAC, Operated by the  
University of Dayton Research Institute (UDRI)  
Bldg 196, Room 8  
2261 Monahan Way  
Wright-Patterson AFB, OH 45433-7022  
Phone: (937) 255-4842; DSN: 785-; Fax: -4823  
E-mail: CSERIAC@cpo.al.wpafb.af.mil  
WWW: <http://cseriac/flight/.html>

**DISTRIBUTION STATEMENT A:** Approved for Public Release; Distribution Unlimited

Although some MOEs/MOPs could logically be aligned in several topics, the Aeronautical System and Human Performance Taxonomy group MOEs/MOPs under the following categories:

### **AERONAUTICAL SYSTEM – HUMAN PERFORMANCE MOE/MOP TAXONOMY**

- System – Maintenance Performance
- Repair Times and Rates
- Turn Time
- Break and Abort Rates, and Delivery Reliability
- Maintenance Manpower
- Operational Readiness, Availability, and Mission-Capable Rates
- Supply and Inventory Analysis
- Maintenance Safety
- Personnel Skill and Training Effectiveness
- System Performance and n Utilization Rates

## System Performance - Maintenance

### Repair Times & Rates

MOE/MOP	DEFINITION	REFERENCE	APPLICATION, EXAMPLE, FINDING
Mean Time Between Maintenance Actions (MTBMA)	The average flying hours between maintenance events, including scheduled & unscheduled events.	AFI 10-602 (USAF/LGMM, 1994), p. 30; AFI 99-102 (AFOTEC/XRX, 1994); Cooper, 1996; JAST, 1995; ANGRC/LGMM, 1997	MOM = Sortie generation Rate
Mean Time Between Removals	<i>self explanatory</i>	AFI 10-602 (USAF/LGMM, 1994)	
Mean Time Between Failure (MTBF)	<i>self explanatory</i>	Chester, 1997; Pinkston, 1997	
Mean Time Between Critical Failure (MTBCF)	The average time between failures of mission-essential system functions.	AFI 10-602 (USAF/LGMM, 1994), p. 30; AFOTEC/XRC, 1994, p. D-53; 1996; AMCPAM 21-102 (AMC/LGQA, 1995), p. 16; Battilega & Grange, 1984, p. 54; Cooper, 1996; JAST, 1995; Chester, 1997; Pinkston, 1997	Divide # of operating hours by # of critical failures
Mean Repair Time (MRT)	The average corrective maintenance time required to return a system or part to operational status.	AFI 10-602 (USAF/LGMM, 1994), p. 31; AFOTEC/XRC, 1991, p. II-7; 1994, p. D-53; 1996; Battilega & Grange, 1984, p. 54; Cooper, 1996; JAST, 1995	
Mean Time to Repair (MTTR)	(No Separate Definition)	AFI 10-602 (USAF/LGMM, 1994)	
Pre-Maintenance Repair Time	The time a serviceable part is issued from Supply until the broken part is received by the backshop for repair.	ACC/LGP, 1995, p. 27	(total # of days in pre-maintenance) ÷ (total # of items repaired) (Pipeline metric, can be calculated from CAMS R&P action taken codes start times but SBSS used more often)
Repair Time	The time a part remains in the shop until repaired, minus time spent awaiting parts.	ACC/LGP, 1995, p. 27	[(total # of days in repair) - (AWP days)] ÷ (total # of items repaired) (Pipeline metric usually taken from SBSS)
Post-Maintenance Repair Time	The time it takes for the repaired part to be turned back into Supply.	ACC/LGP, 1995, p. 27	(total # of days in post-maintenance) ÷ (total # of items repaired) (Pipeline metric usually taken from SBSS)

MOE/MOP	DEFINITION	REFERENCE	APPLICATION, EXAMPLE, FINDING
% of equipment inspected	<i>self explanatory</i>	HQ USAF/XOOT, 1997	
% of equipment repaired	<i>self explanatory</i>	HQ USAF/XOOT, 1997	
% of Aircraft Battle Damage Repair (ABDR) completed	<i>self explanatory</i>	HQ USAF/XOOT, 1997	
Total Failures	Total # of “failures” and induced failures.”	ANGRC/LGMM, 1997	Failures + Induced Failures
Total Repair Cycle Time	The average time, expressed in days, that an unserviceable asset spends in the repair cycle at a unit. This indicator is for aircraft only; it does not include engines or support equipment.	ACC/LGP, 1995, p. 27, 34; ACC/LGPA, 1994, p. 21; PACAF/LGS (No Date)	[(Pre-maintenance days) + (Repair days) + (post-maintenance days) - (AWP days)] ÷ (# of items turned in)
Engine Flow Time	This metric depicts the average # of flow days for aircraft engines. It encompasses the flow time of an engine through organizational level maintenance. Flow time comprises awaiting maintenance (AWM) time, & in work (IW) time. If your wing relies on a QUEEN BEE or regional repair operation, packing, shipping, & transportation will also factor into these rates. The engine flow time should remain steady or decrease. The range will vary based on geographic location, mission, & engine type.	PACAF/LGS (No Date)	
Essential System Repair Time per Flight Hour (ESRT/FH)	Average clock time needed to repair mission-essential equipment per operational flight hour.	AFI 10-602 (USAF/LGMM, 1994), p. 23	Add elapsed corrective maintenance (CM) & elapsed preventive maintenance (PM) performed, divide by flight hours (AFI 10-602 (USAF/LGMM, 1994)).
Fault Detection Rate		AFOTEC/XRC, 1994, p. D-53	
Fault Isolation Rate		AFOTEC/XRC, 1994, p. D-53	

MOE/MOP	DEFINITION	REFERENCE	APPLICATION, EXAMPLE, FINDING
Gold Flag Repair Opportunities	The main objective of the PACAF Gold Flag program is to optimize combat capability by reducing costs using local repair of items or procurement of repair services. Gold Flag also promotes initiatives to find safe, smart innovative repairs. There is no expected rate/range for the return for Gold Flag. Each units program will differ based on the size & capabilities of the unit.	PACAF/LGS (No Date)	Track the # of items evaluated/repared & compare against last year.
Delayed Discrepancy Average, AWM	Average # of delayed discrepancies per aircraft awaiting maintenance (AWM).	AMCPAM 21-102 (AMC/LGQA, 1995), p. 13; ANGR/LGMM, 1997	Total discrepancies delayed for Mx ÷ Adjusted average possessed aircraft
Delayed Discrepancy Average, AWP; *Cross reference to Supply	Average # of delayed discrepancies per aircraft awaiting parts (AWP).	AMCPAM 21-102 (AMC/LGQA, 1995), p. 13; PACAF/LGS (No Date); ANGR/LGMM, 1997□	Total discrepancies delayed for parts ÷ Adjusted average possessed aircraft
Electronic Warfare (EW) Pods Awaiting Parts (AWP) Rate	The total deferred discrepancies for EW Pods which require parts.	ACC/LGP, 1995, p. 18	<i>weekly rate:</i> (total AWP discrepancies) ÷ (average possessed EW Pods) <i>monthly rate:</i> [(AWP rate WK1) + (AWP rate WK2) + (AWP rate WK3) + (AWP rate WK4)... + (AWP rate WK'X')] ÷ (# of weekly rates)
Delayed Discrepancy Rate <sup>5</sup> (Cross reference to Supply)	Average # of delayed discrepancies per possessed aircraft.	AMC/LGQP, 1996; AMCPAM 21-102 (AMC/LGQA, 1995), p. 14; Woehr & Miller, 1995; Woehr, 1996; PACAF/LGS (No Date) ; AETC/LGMMMA, 1996; ANGR/LGMM, 1997	Total delayed discrepancies (AWM + AWP) ÷ Adjusted average possessed aircraft
Deferred Discrepancy Rate <sup>6</sup>	Malfunctions or discrepancies not creating NMC or PMC status but are not corrected “on the spot” are considered deferred discrepancies.	ACC/LGP, 1995, p. 16; 1996; PACAF/LGS (No Date) ; AETC/LGMMMA, 1996	(total # of discrepancies) ÷ (total # of aircraft sampled)

<sup>5</sup> NOTE: “Delayed”

<sup>6</sup> and “deferred” are generally synonymous.

MOE/MOP	DEFINITION	REFERENCE	APPLICATION, EXAMPLE, FINDING
Fix Rate	The # of aircraft that return with inoperable systems & must be returned to MC status within a specified amount of time. The # of aircraft fixed in X amount (4, 8, 12, 24) of hours.	AFI 10-602 (USAF/LGMM, 1994), p. 8; AMC/LGQP, 1996; AMCPAM 21-102 (AMC/LGQA, 1995), p. 14; ACC/LGP, 1995, p. 19; 1996; ACC/LGPA, 1994, p. 19; Klarer, 1997; PACAF/LGS (No Date); AETC/LGMMMA, 1996; ANGRC/LGMM, 1997	$[(\# \text{ of aircraft fixed within "4, 8, 12, 24" hours}) \div (\text{total \# of broken (Code 3) aircraft})] \times (100)$
Critical Test Equipment	The purpose of the critical test equipment metric is to closely monitor the status of broken test equipment & the parts on order to fix them; especially if the equipment has limited availability & will have a major impact on operational capability.	PACAF/LGS (No Date)	
Repeat Rate	The # of times same malfunction occurs on next flight.	AFI 21-101 (USAF/LGMM, 1996); Woehr & Miller, 1995; Woehr, 1996; ACC/LGP, 1995, p. 28; AETC/LGMMMA, 1996; ANGRC/LGMM, 1997	$[(\text{total \# repeat discrepancies}) \div (\text{total \# pilot reported discrepancies})] \times 100$
# of Repeats	<i>self explanatory</i>	ANGRC/LGMM, 1997	
Recur Rate	The # of times same malfunction occurs within next 3 flights.	AFI 21-101 (USAF/LGMM, 1996); Woehr & Miller, 1995; Woehr, 1996; ACC/LGP, 1995, p. 28; AETC/LGMMMA, 1996; ANGRC/LGMM, 1997	$[(\text{total \# recur discrepancies}) \div (\text{total \# pilot reported discrepancies})] \times 100$
Recur Rate	The # of times same malfunction occurs within next 3 flights.	AFI 21-101 (USAF/LGMM, 1996); Woehr & Miller, 1995; Woehr, 1996; ACC/LGP, 1995, p. 28; AETC/LGMMMA, 1996; ANGRC/LGMM, 1997	$[(\text{total \# recur discrepancies}) \div (\text{total \# pilot reported discrepancies})] \times 100$
# of Recurs	<i>self explanatory</i>	ANGRC/LGMM, 1997	
Repeat/Recur Rate	% of all system malfunctions discovered by the aircrew that are repeating or recurring problems.	ACC/LGP, 1995, p. 28; Klarer, 1997; USAFE/LGP, 1997; PACAF/LGS (No Date)	$[(\text{total \# repeat discrepancies}) + (\text{total \# recur discrepancies})] \div [(\text{total \# pilot reported discrepancies})] \times (100)$

MOE/MOP	DEFINITION	REFERENCE	APPLICATION, EXAMPLE, FINDING
Cannot Duplicate (CND)	CNDs are pilot reported discrepancies that maintenance cannot duplicate &/or detect when troubleshooting. It does not mean that the aircraft cannot be repaired; it just means that if “the most likely” component is replaced, operational checks will not confirm a proper repair has been accomplished, as maintenance could not detect a malfunction to begin with.	AFI 21-103 (AFMC/LGMM, 1994); PACAF/LGS (No Date)	# of CNDs ÷ # of total actions
Retest Okay (RTOK); Sometimes used interchangeably with cannot duplicate (CND)	Identifies the item which is received at the maintenance center, tested, found serviceable, & no repair was performed.	<i>Compendium of... Terms</i> , 1981	May be an indicator of inadequate training (e.g., improper completion of troubleshooting), but other contributing factors are also possible
Engine Foreign Object Damage (FOD) Rate	Rate of engine FODs per 1,000 departures or sorties.	AMCPAM 21-102 (AMC/LGQA, 1995), p. 14; PACAF/LGS (No Date)	# of FOD incidents ÷ ([# of departures & sorties] X [#of engines on the aircraft]) X (1,000)
Unscheduled Engine Removals (UERS)	UERS reduce aircraft availability & impact mission capability. An increase in UERS could be due to materiel failure, age of equipment, poor troubleshooting, or poor support shop maintenance.	PACAF/LGS (No Date); ANGRC/LGMM, 1997	Count (not rate) where Type maintenance code = B and work unit code = engines
Engine Preparation for Shipment	Time used to prepare & process engines for shipment to the depot, QUEEN BEE facility, or regional repair facility. This time is used to receive an engine from the flightline, inspect & preserve, prepare engine records, process transportation documents & deliver the engine to the aerial port. The expected rate/range is 1 to 3 days.	PACAF/LGS (No Date)	This rate is compiled by tracking the # of days till shipment. Time between release by engine shop for shipment and time contractor picks up for shipment
<b>Turn Time</b>			
Maintenance Turn Time/Turn Around Time	The time required to prepare a returning mission-capable aircraft for another sortie.	MIL-STD-1776A, 1994, p. 54; <i>UNTL</i> , 1996, p. 212; AFI 10-602 (USAF/LGMM, 1994), p. 10	

MOE/MOP	DEFINITION	REFERENCE	APPLICATION, EXAMPLE, FINDING
Repair Turn Around Time	Measured from the time an item is removed from the aircraft until it is repaired & ready for reissue.	AFOTEC/XRC, 1994, p. D-53; GAO/NSIAD-96-86, p. 1	Air Force standard for repair turnaround times for avionics items is 8 days. Pipeline measure using CAMS and SBSS data to compute all the “buckets” of time in the repair cycle
Mission Preparation Time	The time required to prepare a mission-capable aircraft for a sortie.	JAST, 1995	MOM = Sortie Generation Rate
Aircraft Regeneration Time	# of aircraft regenerated within X amount of time	AFI 90-201/ACC SUP 1 (AFI 90-201/ACC SUP 1 (ACC/IGIX, 1996))	
Aircraft Rearmed Time	<i>self explanatory</i>	JAST, 1995	MOM = Sustain forces & operations
Refueling Time	<i>self explanatory</i>	Cooper, 1996; JAST, 1995; Turner & Bard, 1972, p. 12	MOM = Sortie generation Rate
Bombs Built per Unit Time	# of bombs built & provided per unit of time (e.g., per hour, day, sortie).	Johnson, 1996	
Aircraft Battle Damage Repair Time (ABDRT)	<i>self explanatory</i>	AFI 90-201/AFSOC SUP 1 (AFSOC/IG, 1995); JAST, 1995	MOM = Sortie generation Rate
Mean Logistics Delay Time (MLDT)		Cooper, 1996	Not a widely used term
Mean Down Time (MDT)	The average elapsed time between losing Mission Capable (MC) status & restoring the system to MC status	JAST, 1995; UNTL, 1996, p. 212; AFI 10-602 (USAF/LGMM, 1994), p. 31; Chester, 1997; Pinkston, 1997	MOM = Sortie generation Rate; Not tracked. Can compute using system status portion of CAMS
Reduced Material Condition (RMC)	The % of available systems that can perform only some of the assigned missions due to system malfunction or lack of logistics support.	Battilega & Grange, 1984, p. 55	Not a widely used term
Average Sortie Duration	Average length of sortie expressed as average flying hours per departure or sortie.	AMCPAM 21-102 (AMC/LGQA, 1995), p.12; ACC/LGP, 1996	(Total hours flown) ÷ (Total sorties or departures)
% of Scheduled Sorties Launched	<i>self explanatory</i>	UNTL, 1996, p. 192	
% of Sorties Successfully Completed	<i>self explanatory</i>	UNTL, 1996, p. 192	
% of repairables moved within 24 hours		AFXPY Recommendations - EMAIL	
% of repairables reaching repair facilities within 36 hours		AFXPY Recommendations - EMAIL	

MOE/MOP	DEFINITION	REFERENCE	APPLICATION, EXAMPLE, FINDING
<b><i>Break &amp; Abort Rates, &amp; Delivery Reliability (Overall Maintenance Quality)</i></b>			
System Code 3 Status <sup>7</sup>	A percentage based on the total # of system code 3 discrepancies compared to the total # of sorties flown.	AFI 21-101 (USAF/LGMM, 1996), p. 49; ANGRC/LGMM, 1997	$(\text{Total \# Code 3 discrepancies} \div \text{Total \# Sorties}) \times 100$
Break Rate (same as System Capability Rate)	The % of sorties from which an aircraft returns with an inoperable mission-essential system (Code 3) that was previously operable. System malfunction occurring inflight that renders aircraft Not Mission Capable (NMC) after landing.	AFI 10-602 (USAF/LGMM, 1994), p. 7; AMC/LGQP, 1996; AMCPAM 21-102 (AMC/LGQA, 1995), p. 13; ACC/LGP, 1995, p. 12; 1996; Klarer, 1997; PACAF/LGS (No Date); AETC/LGMMA, 1996; SEMR (No Date); ANGRC/LGMM, 1997; Chester, 1997; Pinkston, 1997	$[(\text{\# of aircraft breaks during the measured period}) \div (\text{\# of sorties flown during the period})] \times (100)$
Air Abort Rate	The % of scheduled sorties which must be canceled due to system malfunction. The diversion of an aircraft back to home station or location other than the destination, prior to normal scheduled mission completion, for reasons related specifically to aircraft systems problems while inflight.	AMC/LGQP, 1996; AMCPAM 21-102 (AMC/LGQA, 1995), p. 13; Battilega & Grange, 1984, p. 54; ACC/LGP, 1995, p. 35; 1996; PACAF/LGS (No Date); AETC/LGMMA, 1996; ANGRC/LGMM, 1997	$[(\text{\# of air aborts}) \div (\text{\# departures or sorties})] \times (100)$
# of Air Aborts	<i>self explanatory</i>	ANGRC/LGMM, 1997	
Ground Abort Rate	% of sorties or departures that aborted of the total attempted departures or sorties.	AMCPAM 21-102 (AMC/LGQA, 1995), p. 15; ACC/LGP, 1995, p. 35; 1996; PACAF/LGS (No Date); AETC/LGMMA, 1996; ANGRC/LGMM, 1997	$[(\text{\# of ground aborts}) \div (\text{\# of sorties flown} + \text{\# of ground aborts})] \times 100$
# of Ground Aborts	<i>self explanatory</i>	ANGRC/LGMM, 1997	
Total Abort Rate	Total air & ground aborts combined.	Woehr & Miller, 1995; Woehr, 1996; ACC/LGP, 1995, p. 35; 1996; ACC/LGPA, 1994, p. 20; Klarer, 1997; USAFE/LGP, 1997; PACAF/LGS (No Date)	$[(\text{\# ground abort rate} + \text{\# air abort rate}) \div (\text{\# of sorties flown} + \text{\# of ground aborts})] \times 100$
Cancellation Rate	% of all scheduled sorties or departures that were canceled.	AMCPAM 21-102 (AMC/LGQA, 1995), p. 13	$([\text{\# of cancellations}] \div [\text{Scheduled departures \& sorties}]) \times 100$

<sup>7</sup> Quality Maintenance Metrics: The AF considers this metric a gauge for determining maintenance performance (AFI 21-101 [USAF/LGMM, 1996], p. 20).

MOE/MOP	DEFINITION	REFERENCE	APPLICATION, EXAMPLE, FINDING
Maintenance-Related In-flight Emergency Rate	A percentage based on the total # of times an aircrew declares an inflight emergency that is maintenance-related compared to the total # of sorties flown.	AFI 21-101 (USAF/LGMM, 1996), p. 54; PACAF/LGS (No Date)	$(\text{Total \# of maintenance inflight emergencies} \div \text{total \# of sorties flown}) \times 100$
Maintenance Delivery Reliability	% of times aircraft is mission capable at scheduled or actual crew show time (whichever is sooner) & aircraft is capable of flight & will be accepted by aircrew	AMCPAM 21-102 (AMC/LGQA, 1995), p. 16	$(\text{Total departures or sorties} - (\text{\# of aircraft broke at scheduled or actual crew show time [whichever is sooner]} \times 100) \div (\text{Total departures or sorties})) \times 100$
Maintenance Plan Scheduling Effectiveness Rate	The effectiveness for the planning & execution of scheduled maintenance actions. The # of planned maintenance actions vs. the actual # of actions performed.	Woehr & Miller, 1995; Woehr, 1996; ACC/LGP, 1995, p. 24; ACC/LGQ, 1995; AFI 21-101 (USAF/LGMM, 1996), p. 53; PACAF/LGS (No Date); AETC/LGMMA, 1996	$([\text{total points earned}] \div [\text{total points possible}]) \times 100$
Maintenance Flying Scheduling Effectiveness Rate	A percentage based on the total # of sorties scheduled on the daily flying schedule minus maintenance-related deviations compared to the total # of sorties scheduled on the daily flying schedule	AFI 21-101 (USAF/LGMM, 1996), p. 53; AETC/LGMMA, 1996	$[(\text{Total \# of sorties scheduled}) - (\text{maintenance deviations}) \div (\text{Total \# of sorties scheduled})] \times 100$
Aircraft/Flying Scheduling Effectiveness Rate	Effectiveness of sortie scheduling & the ability of the unit to meet it.	Woehr & Miller, 1995; Woehr, 1996; ACC/LGP, 1995, p. 20; 1996; ACC/LGQ, 1995; ACC/LGPA, 1994, p. 19; AETC/LGMMA, 1996	$([\text{Adj. Sortie Sched.}] - [\text{chargeable deviations}]) \div [\text{Adj. Sortie Sched.}] \times 100$
On-Schedule Take-off Time( <i>Cross reference to Air Mobility Measures</i> )	Each aircraft must depart home station in accordance with the published schedule or no later than the latest time for mission completion.	AMCI 90-201 (AMC/IGPS, 1996)	
Aircraft Forms Status	A percentage based on the total # of times aircraft AFTO Forms 781A <i>aircraft status</i> match command post/MIS status compared to the # of times sampled.	AFI 21-101 (USAF/LGMM, 1996), p. 52	$(\text{Total \# accurate status} \div \text{total \# status} \text{ sampled}) \times 100$
<b>Maintenance Manpower</b>			
Maintenance Man-Hours per Life Unit (MMH/LU)	MAJCOMs estimate maintenance man-hours per flying hour (MMH/FH) on their specific needs.	AFI 10-602 (USAF/LGMM, 1994), p. 23	

MOE/MOP	DEFINITION	REFERENCE	APPLICATION, EXAMPLE, FINDING
Maintenance Man-Hours per Flying Hour (MMH/FH)- Support	Direct maintenance man-hours required to support a system.	AFI 10-602 (USAF/LGMM, 1994), p. 23; AFI 99-102 (AFOTEC/XRX, 1994); ACC/LGP, 1996	(total direct maintenance data collection man-hours against aircraft & engines) ÷ (hours flown)
MMH/FH - Corrective	For inherent malfunctions, induced malfunctions, no-defect actions, or total events.	AFI 10-602 (USAF/LGMM, 1994), p. 23	
MMH/FH - Improvement	Product improvement	AFI 10-602 (USAF/LGMM, 1994), p. 23 □	
MMH/FH - Preventive	Preventive maintenance (time change items)	UNTL, 1996, p. 212; AFI 10-602 (USAF/LGMM, 1994), p. 23	
MMH/FH	All FH categories totaled	AFI 10-602 (USAF/LGMM, 1994), p. 23; AFOTEC/XRC, 1991, p. II-7; 1994, p. D-53; 1996; AMCPAM 21-102 (AMC/LGQA, 1995), p. 15; JAST, 1995	Total labor-hours documented (aircraft & engines only excluding “Y” type maintenance) ÷ Total flying hours
Scheduled MMH □	<i>self explanatory</i>	ANGRC/LGMM, 1997	
Unscheduled MMH	<i>self explanatory</i>	ANGRC/LGMM, 1997	
Qualified Personnel	A percentage based on the total # of qualified personnel (by AFSC & Skill Level) compared against the total # of maintenance personnel assigned (by AFSC & Skill Level).	AFI 21-101 (USAF/LGMM, 1996), p. 51	(Total # fully qualified personnel ÷ total # assigned personnel) x 100
Trained Technicians	The base training roster depicts all enlisted personnel by unit, in formal upgrade training. It also depicts all enlisted personnel below master sergeant that are in duty position qualification training. Any unit with more than 25% of its personnel in upgrade training may degrade mission accomplishment.	PACAF/LGS (No Date)	The rate is computed by dividing the total # in OJT by the total # of enlisted personnel assigned (total in OJT ÷ total personnel).
Maintenance Personnel per Operational Unit (MP/U)	The total # of direct maintenance personnel needed for each specified operational unit to perform direct on-equipment & off-equipment maintenance.	AFI 10-602 (USAF/LGMM, 1994), p. 23	
Manpower UTE Rate	% of time maintainer occupied by performing maintenance actions on system.	Cooper, 1996	available (possessed) hours ÷ used hours

MOE/MOP	DEFINITION	REFERENCE	APPLICATION, EXAMPLE, FINDING
Assessments, Evaluations, & Inspections (Overall Pass Rate)	The purpose of this metric is to analyze failure trends to improve adherence to policy, guidance & technical data; & to eliminate deviations from prescribed directives to attain the highest quality maintenance.	PACAF/LGS (No Date)	$(\text{passed inspections} \div \text{total inspections}) \times 100$
Adherence to Directives <sup>2</sup>	A percentage based on the total # of passed assessments that follow maintenance policy, guidance, or technical data compared to the total # of assessments.	AFI 21-101 (USAF/LGMM, 1996), p. 56; PACAF/LGS (No Date)	$\text{Total \# passed assessments} \div \text{total (assessments)} \times 100$
<b><i>Operational Readiness, Availability, &amp; Mission Capable Rates</i></b>			
Status of Resources and Training (SORTS) Report	This report provides a broad band of statistical information pertaining to training, personnel, equipment and supplies on hand, and equipment condition.	AFI 10-201 (AF/XOOOR, 1995). PACAF/LGS (No Date); Chester, 1997; Pinkston, 1997	The four rates are computed using the following criteria: - Training: $[\text{MISSION READY and AVAILABLE}] \div \text{ASSIGNED} \times 100$ - Personnel: $\text{PERSONNEL AVAILABLE} \div \text{PERSONNEL REQUIRED} \times 100$ - Critical Personnel: $\text{CRITICAL PERSONNEL AVAILABLE} \div \text{CRITICAL PERSONNEL REQUIRED} \times 100$ - Equipment and Supplies: $\text{POSSED} \div [\text{AUTHORIZED or REQUIRED}] \times 100$ - Equipment Condition: $[\text{MISSION READY and AVAILABLE}] \div \text{POSSESSED} \times 100$
Category Ratings (C-Ratings)	Readiness status of a unit is reported in the SORTS system by assigning Category level ("C" level) that reflect the commander's subjective & objective evaluation based on the four measured areas.	AFI 10-201 (AF/XOOOR, 1995). GAO/NSIAD-96-194, 1996; GAO/T-NSIAD-97-107, 1997; Dudley & Novotny, 1994	
SORTS C-1	Possesses required resources and is trained to undertake the full wartime mission(s) for which it is organized or designed.	AFI 10-201 (AF/XOOOR, 1995). GAO/NSIAD-96-194, 1996; GAO/T-NSIAD-97-107, 1997; Dudley & Novotny, 1994	

MOE/MOP	DEFINITION	REFERENCE	APPLICATION, EXAMPLE, FINDING
SORTS C-2	Possesses required resources and is trained to undertake most of the wartime mission(s) for which it is organized or designed.	AFI 10-201 (AF/XOOOR, 1995). GAO/NSIAD-96-194, 1996; GAO/T-NSIAD-97-107, 1997; Dudley & Novotny, 1994	
SORTS C-3	Possesses required resources and is trained to undertake many, but not all, portions of the wartime mission(s) for which it is organized or designed.	AFI 10-201 (AF/XOOOR, 1995). GAO/NSIAD-96-194, 1996; GAO/T-NSIAD-97-107, 1997; Dudley & Novotny, 1994	
SORTS C-4	Requires additional resources and/or training to undertake its wartime mission(s), but if the situation dictates, it may be required to undertake portions of the mission(s) with resources on hand.	AFI 10-201 (AF/XOOOR, 1995). GAO/NSIAD-96-194, 1996; GAO/T-NSIAD-97-107, 1997; Dudley & Novotny, 1994	
SORTS C-5	Unit is undergoing a service-directed resource change & is not prepared to undertake its wartime mission(s).	AFI 10-201 (AF/XOOOR, 1995). GAO/NSIAD-96-194, 1996; GAO/T-NSIAD-97-107, 1997; Dudley & Novotny, 1994	
SORTS - Equipment and Supplies on Hand	Equipment and supplies on hand supporting item counts and percentages of authorized (S-level).	AFI 10-201 (AF/XOOOR, 1995).	
SORTS - Equipment Condition	Equipment condition supporting item counts and percentages of authorized (R-level).	AFI 10-201 (AF/XOOOR, 1995).	
SORTS – Critical Personnel	Critical personnel available (P-level) as percentage of authorized (for units with multiple weapons systems) by weapon system Program Element Code (PEC) by skill level.	AFI 10-201 (AF/XOOOR, 1995).	
SORTS – Training	Training (T-level) emphasizes training to perform the assigned mission, focusing on related skills.	AFI 10-201 (AF/XOOOR, 1995).	
Availability	The probability that a system is operable & ready to perform its intended mission at any given time.	AFI 10-602 (USAF/LGMM, 1994), p. 7; AFOTEC/XRC, 1994, p. D-53; 1996; JAST, 1995; MIL-STD-1776A, 1994, p. 54	MOM = Sortie generation Rate
Possessed Availability	A % of aircraft availability over the past 12 months.	AMC/LGQP, 1996; Chester, 1997; Pinkston, 1997; ANGRC/LGMM, 1997	

MOE/MOP	DEFINITION	REFERENCE	APPLICATION, EXAMPLE, FINDING
Aircraft Possessed Hours (APH); (roughly equivalent to average possessed aircraft)	Total # of clock hours accumulated for a specified period for all of the possessed aircraft for a unit.	AMCPAM 21-102 (AMC/LGQA, 1995), p. 13; ANGRC/LGMM, 1997	
Average Possessed Aircraft	Average number aircraft possessed per day by unit for specified period of time. EXAMPLE: week, month, 6 months, or 1 year (method used in LG summary & HOF briefing).	AMCPAM 21-102 (AMC/LGQA, 1995), p. 13; ACC/LGP, 1996; Klarer, 1997; AETC/LGMM, 1996; ANGRC/LGMM, 1997	$([\text{Total possessed hours}] \div ([24 \text{ hours}]) \times (\# \text{ of days in the period}))$
Fleet Availability	A total # of aircraft availability, to include depot NMC time for aircraft possessed by depot above & beyond Back-up aircraft inventory (BAI), over the past 12 months.	AMC/LGQP, 1996; SEMR (No Date); Chester, 1997; Pinkston, 1997	
Time Left to Phase	To keep aircraft availability high, it is important to properly manage the phase flow to preclude several phases coming due at the same time causing bottlenecks & backlogs, or over-flying an aircraft past its inspection interval, grounding aircraft, & impacting mission capability. Fleet average time left to phase should be close to 50% of the phase interval & should be evenly staggered along a 45 degree slope.	PACAF/LGS (No Date); ANGRC/LGMM, 1997	
Operationally Ready (OR) Rate	The % of available systems which can perform all missions at any point in time.	Battilega & Grange, 1984, p. 55	
Aircraft Mission Supportability <sup>2</sup>	A percentage based on the total # of possessed aircraft capable of accomplishing a specific basic systems list mission compared to the total # of possessed aircraft assigned that basic systems list.	AFI 21-101 (USAF/LGMM, 1996), p. 55	$(\text{Total \# aircraft capable of performing each basic systems list} \div \text{total \# possessed aircraft tasked for each basic systems list}) \times 100$

MOE/MOP	DEFINITION	REFERENCE	APPLICATION, EXAMPLE, FINDING
Mission Capable (MC) Rate	% of APH that were fully and partially MC (FMC & PMC) for a unit over a specified period.	AFI 21-103 (AFMC/LGMM, 1994); AFI 99-102 (AFOTEC/XRX, 1994); AMC/LGQP, 1996; AMCPAM 21-102 (AMC/LGQA, 1995), p. 16; JAST, 1995; AFI 10-602 (USAF/LGMM, 1994), p. 10; ACC/LGP, 1995, p. 25; 1996; ACC/LGPA, 1994, p. 19; Klarer, 1997; USAFE/LGP, 1997; PACAF/LGS (No Date); AETC/LGMMA, 1996; SEMR (No Date); ANGRC/LGMM, 1997; Chester, 1997; Pinkston, 1997	$([FMC \text{ hours}] + [PMC \text{ hours}]) \times (100) \div (APH)$
Total Flyable (TF) Rate	The aircraft can fly.	AFI 21-103 (AFMC/LGMM, 1994)	FMC, PMC, & NMCA added together equal TF.
Fully Mission Capable (FMC) Rate	% of APH that were FMC for a unit over a specified period.	AFI 21-103 (AFMC/LGMM, 1994); AFI 10-602 (USAF/LGMM, 1994), p. 10; AFOTEC/XRC, 1994, p. D-53; AMCPAM 21-102 (AMC/LGQA, 1995), p. 15; AETC/LGMMA, 1996; ANGRC/LGMM, 1997	$(FMC \text{ hours}) \times (100) \div (APH)$
Partially Mission Capable (PMC) Rate	Can perform at least one but not all of its assigned missions.	AFI 21-103 (AFMC/LGMM, 1994); AFI 10-602 (USAF/LGMM, 1994), p. 10; AMCPAM 21-102 (AMC/LGQA, 1995), p. 17	$(PMC \text{ hours}) \times (100) \div (APH)$
Partially Mission Capable Maintenance (PMCM) Rate	Material condition of an aircraft or training device indicating that it can perform at least one, but not all, of its missions because of maintenance requirements existing on the inoperable subsystem(s).	AFI 21-103 (AFMC/LGMM, 1994); AETC/LGMMA, 1996; ANGRC/LGMM, 1997	$(PMCM \text{ hours} \div \text{total possessed aircraft hours}) \times 100$
Partially Mission Capable Supply (PMCS) Rate	Material condition of an aircraft or training device indicating that it can perform at least one, but not all, of its missions because maintenance required to clear the discrepancy cannot continue due to a supply shortage.	AFI 21-103 (AFMC/LGMM, 1994); AETC/LGMMA, 1996; ANGRC/LGMM, 1997	$(PMCS \text{ hours} \div \text{total possessed aircraft hours}) \times 100$
Partially Mission Capable Both (PMCB)	The aircraft can do at least one, but not all, of its assigned missions because of both maintenance & supply.	AFI 21-103 (AFMC/LGMM, 1994); Woehr & Miller, 1995; Woehr, 1996; AETC/LGMMA, 1996; ANGRC/LGMM, 1997	$(PMCB \div APH) \times 100$

MOE/MOP	DEFINITION	REFERENCE	APPLICATION, EXAMPLE, FINDING
Total Partially Mission Capable - Supply (TPMCS)	The aircraft can do at least one, but not all, of its assigned missions because of supply.	AFI 21-103 (AFMC/LGMM, 1994) ; ANGRC/LGMM, 1997	PMCS & PMCB added together equal TPMCS.
Total Partially Mission Capable - Maintenance (TPMCM)	The aircraft can do at least one, but not all, of its assigned missions because of maintenance.	AFI 21-103 (AFMC/LGMM, 1994) ; ANGRC/LGMM, 1997	PMCM & PMCB added together equal TPMCM.
Electronic Warfare (EW) Pods MC Rate	% of all possessed EW Pods that are capable of fulfilling their wartime missions.	ACC/LGP, 1995, p. 17; PACAF/LGS (No Date)	(# serviceable Pods) ÷ (# of possessed Pods)
Aerospace Ground Equipment (AGE) MC Rate	AGE support is often overlooked but can limit flightline operational capability. It must be inspected, maintained, & repaired in a timely, prescribed manner. Some examples include measuring powered AGE critical limits status or MC status. Another way is to track overdue inspections. MC rates should exceed 90% & overdue inspections should be very near zero.	PACAF/LGS (No Date)	(# of serviceable units ÷ total # of units) x 100
LANTIRN MC Rate	% of all possessed LANTIRN Pods that are capable of fulfilling their wartime missions.	ACC/LGP, 1995, p. 21	(# serviceable Pods) ÷ (# of possessed Pods)

MOE/MOP	DEFINITION	REFERENCE	APPLICATION, EXAMPLE, FINDING
LANTIRN Test MC Status	LANTIRN test station mission capability evaluates the ability of the shelter test equipment to bench check the 16 testable LRUs.	ACC/LGP, 1995, p. 22	LANTIRN test station capability is computed by calculating the ability of the shelter test equipment to bench check the 16 LRUs. <b>Example:</b> LANTIRN Intermediate Automatic Test Equipment - 10 unit test capability <b>Example:</b> 40% MC = 4/10 units testable <b>Power Supply Test Station</b> - 4 unit test capability <b>Example:</b> 75% MC = 3/4 units testable <b>Environmental Control Unit Test Station</b> - 2 unit test capability <b>Example:</b> 50% MC = 1/2 units testable
Not Mission Capable (NMC) Rate	Aircraft cannot perform any of its assigned missions.	AFI 21-103 (AFMC/LGMM, 1994); AFI 10-602 (USAF/LGMM, 1994), p. 10; AMCPAM 21-102 (AMC/LGQA, 1995), p. 16	$(\text{NMC hours}) \times (100) \div (\text{APH})$
Not Mission Capable Supply (NMCS); <i>*Cross reference to Supply</i>	The aircraft can't do any of its assigned missions because of supply. The aircraft can't fly (restricted from use).	AFI 21-103 (AFMC/LGMM, 1994); AFI 10-602 (USAF/LGMM, 1994), p. 10; AMCPAM 21-102 (AMC/LGQA, 1995), p. 16; AETC/LGMM, 1996; ANGRC/LGMM, 1997	$(\text{NMCSBU hours} \div \text{total possessed aircraft hours}) \times 100$
Engine Not Mission Capable Supply (ENMCS); <i>*Cross reference to Supply</i>	ENMCS measures the time an engine is down for part(s). It shows the time an engine cannot be brought to MC status due to the non-availability of part(s). A high ENMCS rate indicates reduced capacity to support flying operations with spare engines.		The metric is depicted by tracking the number of days an engine(s) is awaiting parts.
Not Operationally Ready - Supply (NORS); <i>*Cross reference to Supply</i> ; replaced by NMCS	The % of total systems not operationally available due to lack of parts.	Battilega & Grange, 1984, p. 54	
Not Operationally Ready - Supply - Flying (NORS-F); <i>*Cross reference to Supply</i> ; Replaced by NMCSA	The % of available aircraft in a reduced material condition due to supply, but are flyable & can perform some missions.	Battilega & Grange, 1984, p. 55	
Not Operationally Ready - Supply-Ground (NORS-G); <i>*Cross reference to Supply</i> ; Replaced by NMCS	The % of available aircraft which are grounded due to lack of logistics support.	Battilega & Grange, 1984, p. 55	

MOE/MOP	DEFINITION	REFERENCE	APPLICATION, EXAMPLE, FINDING
Not Mission Capable - Maintenance (NMCM)	The aircraft can't do any of its assigned missions because of maintenance. The aircraft can't fly (restricted from use).	AFI 21-103 (AFMC/LGMM, 1994); AFI 10-602 (USAF/LGMM, 1994), p. 10; AMCPAM 21-102 (AMC/LGQA, 1995), p. 16; SEMR (No Date)	
Not Operationally Ready - Maintenance (NORM); Replaced by NMCM	The % of total systems not operationally available due to unperformed required maintenance.	Battilega & Grange, 1984, p. 54	
Not Operationally Ready - Maintenance - Flying (NORM-F); Replaced by NMCMA	The % of available aircraft in a reduced material condition due to maintenance, but which are flyable & can perform some missions.	Battilega & Grange, 1984, p. 55	
Not Operationally Ready Maintenance - Ground (NORM-G); Replaced by NMCM	The % of available aircraft which are grounded due to lack of logistics support.	Battilega & Grange, 1984, p. 55	
Not Mission Capable - Both (NMCB) Rate	The aircraft can't do any of its assigned missions because of maintenance and supply. The aircraft can't fly (restricted from use).	AFI 21-103 (AFMC/LGMM, 1994); AFI 10-602 (USAF/LGMM, 1994), p. 10; AMCPAM 21-102 (AMC/LGQA, 1995), p. 16; Woehr & Miller, 1995; Woehr, 1996	$(NMCB \div APH) \times 100$
Not Mission Capable - Airworthy (NMCA)	The aircraft can't do any of its assigned missions. The aircraft can fly (not restricted from use).	AFI 21-103 (AFMC/LGMM, 1994)	
Not Mission Capable Maintenance - Airworthy (NMCMA)	The aircraft can't do any of its assigned missions because of maintenance. The aircraft can fly (not restricted from use).	AFI 21-103 (AFMC/LGMM, 1994)	
Not Mission Capable Supply - Airworthy (NMCSA)* <i>Cross reference to Supply</i>	The aircraft can't do any of its assigned missions because of supply. The aircraft can fly (not restricted from use).	AFI 21-103 (AFMC/LGMM, 1994)	
Not Mission Capable Both - Airworthy (NMCBA)	The aircraft can't do any of its assigned missions because of both maintenance & supply. The aircraft can fly (not restricted from use).	AFI 21-103 (AFMC/LGMM, 1994)	
Not Mission Capable Maintenance - Scheduled (NMCMS) Rate	The aircraft can't do any of its assigned missions because of unfinished required inspections or scheduled maintenance. The aircraft can't fly (restricted from use).	AFI 21-103 (AFMC/LGMM, 1994) ; AETC/LGMM, 1996; ANGRC/LGMM, 1997	$(NMCMS \text{ hours} \div \text{total possessed aircraft hours}) \times 100$

MOE/MOP	DEFINITION	REFERENCE	APPLICATION, EXAMPLE, FINDING
Not Mission Capable Both - Scheduled (NMCBS) Rate	The aircraft can't do any of its assigned missions because of both supply & unfinished required inspections or scheduled maintenance. The aircraft can't fly (restricted from use).	AFI 21-103 (AFMC/LGMM, 1994) ; AETC/LGMMA, 1996; ANGRC/LGMM, 1997	$(\text{NMCBS hours} \div \text{total possessed aircraft hours}) \times 100$
Not Mission Capable Maintenance - Unscheduled (NMCMU) Rate	The aircraft can't do any of its assigned missions because of unfinished, unscheduled maintenance. The aircraft can't fly (restricted from use).	AFI 21-103 (AFMC/LGMM, 1994); AETC/LGMMA, 1996; ANGRC/LGMM, 1997	$(\text{NMCMU hours} \div \text{total possessed aircraft hours}) \times 100$
Not Mission Capable Both - Unscheduled (NMCBU) Rate	The aircraft can't do any of its assigned missions because of both supply & unfinished repair or reinstallation. The aircraft can't fly (restricted from use).	AFI 21-103 (AFMC/LGMM, 1994) ; AETC/LGMMA, 1996; ANGRC/LGMM, 1997	$(\text{NMCBU hours} \div \text{total possessed aircraft hours}) \times 100$
Not Mission Capable Maintenance Scheduled - Airworthy (NMCMSA)	The aircraft can't do any of its assigned missions due to unfinished inspections or scheduled maintenance. The aircraft can fly (not restricted from use).	AFI 21-103 (AFMC/LGMM, 1994)	
Not Mission Capable Maintenance Unscheduled - Airworthy (NMCMUA)	The aircraft can't do any of its assigned missions because of unfinished, unscheduled maintenance. The aircraft can fly (not restricted from use).	AFI 21-103 (AFMC/LGMM, 1994)	
Not Mission Capable Both Scheduled - Airworthy (NMCBSA)	The aircraft can't do any of its assigned missions because of both supply & unfinished required inspections or scheduled maintenance. The aircraft can fly (not restricted from use).	AFI 21-103 (AFMC/LGMM, 1994)	
Not Mission Capable Both Unscheduled - Airworthy (NMCBUA)	The aircraft can't do any of its assigned missions because of both supply & unfinished repair or reinstallation. The aircraft can fly (not restricted from use).	AFI 21-103 (AFMC/LGMM, 1994)	
Total Not Mission Capable (TNMC)	The aircraft can't do any of its assigned missions. Same as NMC.	AFI 21-103 (AFMC/LGMM, 1994)	NMCS, NMCSA, NMCMU, NMCMS, NMCMUA, NMCMSA, NMCBS, NMCBU, NMCBUA, & NMCBSA added together equal TNMC.

MOE/MOP	DEFINITION	REFERENCE	APPLICATION, EXAMPLE, FINDING
Total Not Mission Capable - Supply (TNMCS) □ *Cross reference to Supply	The aircraft can't do any of its assigned missions because of supply.	AFI 21-103 (AFMC/LGMM, 1994); ACC/LGP, 1995, p. 32; 1996; Klarer, 1997; PACAF/LGS (No Date); AETC/LGMM, 1996; SEMR (No Date); ANGRC/LGMM, 1997; Chester, 1997; Pinkston, 1997	NMCS, NMCBU, NMCBS, NMCSA, NMCBUA, & NMCBSA added together equal TNMCS.
Total Not Mission Capable - Maintenance (TNMCM)	The aircraft can't do any of its assigned missions because of maintenance.	AFI 21-103 (AFMC/LGMM, 1994); ACC/LGP, 1995, p. 31; 1996; Klarer, 1997; PACAF/LGS (No Date); AETC/LGMM, 1996; ANGRC/LGMM, 1997	NMCMU, NMCMS, NMCBU, NMCBS, NMCMLA, NMCMSA, NMCBUA, & NMCBSA added together equal TNMCM.
Total Not Mission Capable - Airworthy (TNMCA)	Same as NMCA.	AFI 21-103 (AFMC/LGMM, 1994)	NMCBA, NMCMA, NMCSA, NMCBUA, NMCBSA, NMCMLA, & NMCMSA added together equal TNMCA.
<b>Supply &amp; Inventory Analysis</b>			
Receiving - Supply	Receiving is a key process in producing parts & equipment to establish our major supply product--inventory. Before any asset or part becomes a piece of supply's inventory is must be receipted into the supply account.	PACAF/LGS (No Date)	
% of supplies available compared to requirements	<i>self explanatory</i>	HQ USAF/XOOT, 1997	
% of required supplies delivered	<i>self explanatory</i>	HQ USAF/XOOT, 1997	
Days after required date that replenishment stocks are delivered	<i>self explanatory</i>	HQ USAF/XOOT, 1997	
% of major equipment shortfalls causing unit mission delays	<i>self explanatory</i>	HQ USAF/XOOT, 1997	
% of minimum safety level of build up stocks maintained at staging areas	<i>self explanatory</i>	HQ USAF/XOOT, 1997	
% of required reception and onward movement support available	<i>self explanatory</i>	HQ USAF/XOOT, 1997	
% of equipment missing or stolen	<i>self explanatory</i>	HQ USAF/XOOT, 1997	
% of missions with fuel available on schedule	<i>self explanatory</i>	HQ USAF/XOOT, 1997	

MOE/MOP	DEFINITION	REFERENCE	APPLICATION, EXAMPLE, FINDING
% of fuel and petroleum products available compared to requirements	<i>self explanatory</i>	HQ USAF/XOOT, 1997	
% of required fuel and petroleum products delivered	<i>self explanatory</i>	HQ USAF/XOOT, 1997	
Inventory Accuracy Rate	The inventory accuracy rate metric data allows supply to correct errors in processing & storage.	PACAF/LGS (No Date)	$[(\# \text{ of units over} + \# \text{ of units short}) \div \text{total record balance inventoried}] - 100$
Due-In Record Not Loaded	The due-in record not loaded is significant because it informs supply of the amount of property being received for which there is <i>no record of ever ordering</i> . Expect to have less than 1% of total receipts fall into this category.	PACAF/LGS (No Date)	$\text{receipts not due-in} \div \text{total \# of receipts}$
Excess Inventory	The amount of on-hand & on-order inventory. The expected rate for on-hand excess is 3% or less of total inventory while on-order should be less than 1% of total assets due-in.	PACAF/LGS (No Date)	$\text{potential excess} \div \text{total assets}$
Storage Process	Some amount of inventory must be kept on hand & must be separated to better control & track these assets. Storing inventory is costly & needs to be monitored. Furthermore, warehouse management must be made as efficient as possible.	PACAF/LGS (No Date)	
Fill Rate	The % of item requests actually satisfied (this is in terms of \$ value of requisitions or a # of items requested).	Battilega & Grange, 1984, p. 53, USAFE/LGP, 1997; Chester, 1997; Pinkston, 1997	
Expected Back Orders (EBO)	The # of requisitions at any point in time which cannot be filled at a given supply level & which must be passed to the next higher level.	Battilega & Grange, 1984, p. 54	
Cost per Flying Hour	Tracks unit aircraft maintenance financial execution <b>for supplies</b> in relation to hours flown.	ACC/LGP, 1995, p. 15	$(\text{obligations}) \div (\text{hours flown})$
Supply Issue Effectiveness Rate	% of time that Base Supply will have a part in stock when a maintenance organization needs it for repair.	ACC/LGP, 1995, p. 30; Klarer, 1997; USAFE/LGP, 1997; PACAF/LGS (No Date); AETC/LGMMA, 1996; Chester, 1997; Pinkston, 1997	$[(\text{Line items issued}) \div (\text{line items issued} + \text{line items backordered})] \times (100)$

MOE/MOP	DEFINITION	REFERENCE	APPLICATION, EXAMPLE, FINDING
Issue Process	The issuing process is where the asset or inventory (parts, fuels, etc.) finally changes hands from supply to the customer. The delivery of assets in a timely manner is a key element in the issuing process.	PACAF/LGS (No Date)	
Priority Delivery Time	The Priority Delivery Time metric data is collected from the start & stop times of deliveries. This metric represents an AF standard of performance for the delivery of supplies to customers. Expect to deliver 95% of priority assets in less than 30 minutes.	PACAF/LGS (No Date)	$\# \text{ of priority deliveries within 30 minutes} \div \text{total} \# \text{ of priority deliveries}$
Bench Stock Availability Rate	Bench stock should be available when the crew chief needs it. Basically, they should be available in the bin for the customer 95% of the time.	PACAF/LGS (No Date); AETC/LGMMA, 1996	$(\text{authorized line items} - \text{backorders outstanding}) \div \text{line items authorized}$
Supplies Consumed vs. Provided	Ratio of the quantity of supplies consumed to the quantity of supplies provided.	Bornman, 1993, p.3-4	$\text{Ratio} = \text{supply consumed} \div \text{supply provided}$
Overall Vehicle In-Commission (VIC) Rate	Measures the in-commission rate for the command vehicle fleet.	USAFE/LGP, 1997	
General Purpose VIC Rate	Measures the in-commission rate for the general purpose vehicle fleet.	USAFE/LGP, 1997 □	□
Special Purpose VIC Rate	Measures the in-commission rate for the special purpose vehicle fleet	USAFE/LGP, 1997	
Delayed Take-Offs (due to fuels)	This metric tracks delayed take-offs because of fuels. Aircraft missing their scheduled take-off time is a significant metric & must be reviewed to see if fuel was involved. Normally, a fuels delay is caused by excessive responses or equipment failure. The expected monthly rate is 0.	PACAF/LGS (No Date)	$\# \text{ of delayed takeoffs for fuels} \div \text{total} \# \text{ of take-offs}$
Equipment In-Commission Rate	Measures the in-commission rate for the 463L (cargo aircraft loading) vehicle fleet	USAFE/LGP, 1997	

MOE/MOP	DEFINITION	REFERENCE	APPLICATION, EXAMPLE, FINDING
Spare Engine Level	Spare engines offer some flexibility when things go wrong, time changes are due, & when conducting deployed operations. Spare engine status should be monitored daily to ensure sufficient assets are available to meet your target serviceable requirement (TSR).	PACAF/LGS (No Date); Klarer, 1997; Chester, 1997; Pinkston, 1997	The rate is tracked by comparing the # of available spares to your TSR.
Delayed Discrepancy Rate; ( <i>Cross reference to Supply</i> )	Average # of delayed discrepancies per possessed aircraft.	AMC/LGQP, 1996; AMCPAM 21-102 (AMC/LGQA, 1995), p. 14; Woehr & Miller, 1995; Woehr, 1996; PACAF/LGS (No Date); ANGRC/LGMM, 1997	Total delayed discrepancies (AWM + AWP) ÷ Adjusted average possessed aircraft
Delayed Discrepancy Average, AWP* <i>Cross reference to Repair Times &amp; Rates</i>	Average # of delayed discrepancies per aircraft awaiting parts (AWP).	AMCPAM 21-102 (AMC/LGQA, 1995), p. 13; PACAF/LGS (No Date); ANGRC/LGMM, 1997	Total discrepancies delayed for parts ÷ Adjusted average possessed aircraft
Mean Supply Response Time (MSRT)	The average time elapsed between the placing of a requisition & the delivery of the item. Includes order & ship time, any backorder time, etc.	Battilega & Grange, 1984, p. 54	
Not Operationally Ready - Supply (NORS); * <i>Cross reference to Operational Readiness, Availability, &amp; Mission Capable Rates</i>	The % of total systems not operationally available due to lack of parts.	Battilega & Grange, 1984, p. 54	
Not Operationally Ready - Supply - Flying (NORS-F); * <i>Cross reference to Operational Readiness, Availability, &amp; Mission Capable Rates</i>	The % of available aircraft in a reduced material condition due to supply, but which are flyable & can perform some missions.	Battilega & Grange, 1984, p. 55	
Not Operationally Ready - Supply-Ground (NORS-G); * <i>Cross reference to Operational Readiness, Availability, &amp; Mission Capable Rates</i>	The % of available aircraft which are grounded due to lack of logistics support.	Battilega & Grange, 1984, p. 55	
Partially Mission Capable Supply (PMCS); * <i>Cross reference to Operational Readiness, Availability, &amp; Mission Capable Rates</i>	Material condition of an aircraft or training device indicating that it can perform at least one, but not all, of its missions because maintenance required to clear the discrepancy cannot continue due to a supply shortage.	AFI 21-103 (AFMC/LGMM, 1994)	

MOE/MOP	DEFINITION	REFERENCE	APPLICATION, EXAMPLE, FINDING
Total Not Mission Capable - Supply (TNMCS); <i>*Cross reference to Operational Readiness, Availability, &amp; Mission Capable Rates</i>	The aircraft can't do any of its assigned missions because of supply.	AFI 21-103 (AFMC/LGMM, 1994); ACC/LGP, 1995, p. 32; 1996; Klarer, 1997; PACAF/LGS (No Date); SEMR (No Date); ANGRC/LGMM, 1997; Chester, 1997; Pinkston, 1997	NMCS, NMCBU, NMCBS, NMCSA, NMCBUA, & NMCBSA added together equal TNMCS.
Not Mission Capable Supply (NMCS); <i>*Cross reference to Operational Readiness, Availability, &amp; Mission Capable Rates</i>	The aircraft can't do any of its assigned missions because of supply. The aircraft can't fly (restricted from use).	AFI 21-103 (AFMC/LGMM, 1994); AFI 10-602 (USAF/LGMM, 1994), p. 10; AMCPAM 21-102 (AMC/LGQA, 1995); ANGRC/LGMM, 1997	
Not Mission Capable Supply - Airworthy (NMCSA); <i>*Cross reference to Operational Readiness, Availability, &amp; Mission Capable Rates</i>	The aircraft can't do any of its assigned missions because of supply. The aircraft can fly (not restricted from use).	AFI 21-103 (AFMC/LGMM, 1994)	
Engine Not Mission Capable Supply (ENMCS); <i>*Cross reference to Operational Readiness, Availability, &amp; Mission Capable Rates</i>	ENMCS measures the time an engine is down for part(s). It shows the time an engine cannot be brought to MC status due to the non-availability of part(s). A high ENMCS rate indicates reduced capacity to support flying operations with spare engines.	PACAF/LGS (No Date); Chester, 1997; Pinkston, 1997; SEMR (No Date)	The metric is depicted by tracking the number of days an engine(s) is awaiting parts.
<b>Munitions</b>			
Receiving - munitions	Inspect incoming munitions shipments to see that their documentation contains all the information needed to properly identify the items, plus any special handling or storage requirements. The significance of these actions is to maintain accurate accountability, receipt notification to shipper, & visibility.	PACAF/LGS (No Date)	To compute the rate, compare actual processing times (days) to the standard.
% of munitions available compared to requirements	<i>self explanatory</i>	HQ USAF/XOOT, 1997	
% of required munitions delivered	<i>self explanatory</i>	HQ USAF/XOOT, 1997	
% of missions with munitions available on schedule	<i>self explanatory</i>	HQ USAF/XOOT, 1997	
% of high priority targets with preferred munitions available	<i>self explanatory</i>	HQ USAF/XOOT, 1997	

MOE/MOP	DEFINITION	REFERENCE	APPLICATION, EXAMPLE, FINDING
Weapons Load Crew Certification	Weapons load crews are an essential part of the unit & require special training because of the explosive material they handle. Load crew members must perform monthly proficiency loads & quarterly evaluations on 1 or more items on which they are certified. If an individual receives a failed rating during any of these events, he/she must be recertified on that munition to load it again. Load crew training also provides recurring training on munitions that are not used day to day, but are required for wartime taskings. Units will maintain 85% of authorized load crews fully certified & 95% of all authorized load crews formed & in training.	PACAF/LGS (No Date)	The rate is derived by dividing the # of certified load crews by the # of authorized load crews.
Record Accuracy	The resulting actual count, location, & condition information locations of stock on-hand or in-use.	PACAF/LGS (No Date)	The accuracy rate is computed by comparing physical counts against applicable computer records.
Munitions Storage Capacity	Identify & preserve facilities & areas to store & maintain munitions & explosives to meet AF warfighting needs will be measured by volume. The required volume of indoor munitions storage will be determined using the War Consumables Distribution Order (WCDO) quantities, mobility munitions quantities, & training munitions quantities. 2nd, the indoor volume capacity of the munitions area will be determined considering both present facilities & planned (funded) construction. 3rd, the volume presently used for storage of WCDO, mobility, & training munitions will be determined. Compliance will be measured by comparing requirements to maximum capacity.	AFPD 21-2 (USAF/LGMW, 1993), p. 4	

MOE/MOP	DEFINITION	REFERENCE	APPLICATION, EXAMPLE, FINDING
Munitions Inventory Accuracy	Compliance with AF policy to account for munitions will be measured by comparing record balances on the day the records are closed for inventory against physical inventory results. Inventory differences will be measured by the # of lot #s with quantity discrepancies as compared to the overall # of lots assigned to a unit.	AFPD 21-2 (USAF/LGMW, 1993), p. 4; PACAF/LGS (No Date)	To compute the accuracy rate, compare the physical count against accountable record balances.
Nuclear Weapons Accountability	Compliance with nuclear weapon accountability will be assessed by taking measurements in Weapon Status Reporting (WSR). The AF standard is that 100% of all WSRs will be error-free, & transmitted to Field Command Defense Nuclear Agency within 1 day of occurrence.	AFPD 21-2 (USAF/LGMW, 1993), p. 4	
Nuclear Weapons Movements	The measurement for nuclear weapons movements will be made by comparing the # of surface shipments to air shipments. The measure of merit is to reduce total shipments indicating the minimum amount of movement & increased use of Safe Secure Transport.	AFPD 21-2 (USAF/LGMW, 1993), p. 4	
Deferred Maintenance - Awaiting Maintenance/Parts (AWM/AWP)	The deferred maintenance (AWM,AWP) tracks unserviceable, reparable items for repair actions & returns them to a serviceable condition as quickly as possible.	PACAF/LGS (No Date)	The rate is computed by dividing the total # into the # over 180 days old.
Facilities Condition	Tracks the condition of each facility and what actions are taken to maintain them in a combat ready state & aesthetically pleasing manner. Munitions units should track the # of facility discrepancies, work orders submitted against them, & work orders scheduled for repair or completed.	PACAF/LGS (No Date)	To determine a rate, compare the # of work orders submitted against the # scheduled & completed.

MOE/MOP	DEFINITION	REFERENCE	APPLICATION, EXAMPLE, FINDING
Aircrew Munitions Expenditures	Units should closely monitor all munitions expenditures to ensure they are in line with yearly allocated quantities. Units should compare actual expenditures with the calculated straight line of allocated munitions. This metric is important to ensure allocations are sufficient to support training needs & that allocation quantities for the year are met but not exceeded.	PACAF/LGS (No Date)	The rate can be determined by dividing actual expenditures by expected expenditures.
Weapons Release Reliability Rate	Weapons release problems fall under the Weapons Flight. Once the Alternate Mission Equipment (AME) is removed from the aircraft, armament systems specialists (logistics group) troubleshoot the problem or recondition assets as required. A low weapons release rate may reflect poor flightline or support shop troubleshooting skills, defective AME or test sets.	PACAF/LGS (No Date)	$(\text{successful releases} \div \text{attempted releases}) \times 100$
Gun Reliability Rate	Any problems with the aircraft gun will be troubleshoot by flightline weapons personnel. Once the gun is removed, support shop armament technicians (logistics group) take over. Persistent problems with the gun system may reflect poor flightline or support shop troubleshooting skills, overdue inspections, or failing equipment.	PACAF/LGS (No Date)	$(\text{successful firings} \div \text{total attempts}) \times 100$
<b><i>Maintenance Safety</i></b>			
Impoundments	Aircraft and equipment impoundments are used to investigate ground or flight incidents involving safety of flight, other safety incidents, possible maintenance malpractice or multiple repeats/recurs on the same aircraft.	PACAF/LGS (No Date)	

MOE/MOP	DEFINITION	REFERENCE	APPLICATION, EXAMPLE, FINDING
Maintenance-Related On-duty Ground Mishaps	A percentage based on the total # of Class C ground mishaps	AFI 21-101 (USAF/LGMM, 1996), p. 50; PACAF/LGS (No Date)	(Total # Class C ground mishaps ÷ Total # maintenance personnel) x 100 May have a training component (e.g., properly trained personnel have fewer accidents)
% of accidents attributed to human error (last 12 months)	<i>self explanatory</i>	HQ USAF/XOOT, 1997	
% of force lost to non battle injury or disease in theater of operation/Area of Responsibility (AOR)	<i>self explanatory</i>	HQ USAF/XOOT, 1997	
% of people with lost time, because of contact with hazardous materials	<i>self explanatory</i>	HQ USAF/XOOT, 1997	
% of people with lost time, because of work related accidents	<i>self explanatory</i>	HQ USAF/XOOT, 1997	
Incidents of Class A flying mishaps per 100,000 flying hours	<i>self explanatory</i>	HQ USAF/XOOT, 1997	
Failure Modes & Effects Analysis (FMEA)	(1) identifies & documents all possible failure modes of a component or subsystem & (2) determines the effects of each failure mode upon the capability of the system or subsystem to perform its essential functions. Is usually conducted by personnel in the reliability, maintainability, or safety discipline. The types of component failure modes generally considered include premature operation, failure to operate, failure to cease operation, failure during operation, & degraded or out-of-tolerance operation.	Ball, 1985; MIL-STD-1776A, 1994, p. 54	
<b>Personnel Skill and Training Effectiveness</b>			
Personnel Capability	The extent to which personnel are capable of performing assigned tasks.	CJCSM, 1996	Descriptors: High (fully trained and equipped); Partial (partially trained and equipped); Low (poorly trained and equipped)

## System Performance

### Performance Capabilities

MOE/MOP	DEFINITION	REFERENCE	APPLICATION, EXAMPLE, FINDING
System Capability Rate	Measures a system's capability to perform. Computes the % of time a system is fully operable (codes 3/4 discrepancies).	AMCPAM 21-102 (AMC/LGQA, 1995), p. 18	$([\text{Sorties flown}] - [\text{system not used}] - [\text{system}] \times 100) \div (\text{Sorties flown})$
System Reliability Rate	Measure systems reliability to perform. Computes % of time a system is fully operable & partially operable (codes 2/3/4 discrepancies).	AMCPAM 21-102 (AMC/LGQA, 1995), p. 18; PACAF/LGS (No Date)	$([\text{Sorties flown}] - [\text{system not used}] - [\text{system}] \times 100) \div (\text{Sorties flown})$
Weapon System Reliability	Used to measure the probability that a system with a record of completing a specified mission will continue to do so.	AFI 10-602 (USAF/LGMM, 1994), p. 7	Divide the # of missions completed successfully by # of missions attempted.
Dropped Object Rate	Rate of dropped object per 100 sorties. Dropped objects may be a manifestation of material, personnel, or design deficiencies.	AMC/LGQP, 1996; AMCPAM 21-102 (AMC/LGQA, 1995), p. 14; PACAF/LGS (No Date)	$(\# \text{ of dropped object incidents}) \times (100) \div (\# \text{ of departures or sorties})$
# of Aircraft Necessary to Perform Mission	<i>self explanatory</i>	Rau & Egbert, 1972	
Aircrew Manning Ratios; *Cross reference to Air Mobility & Air Combat measures.	Sortie generation capability is effected by low manning ratios and low Optempo. Air Reserve Component (ARC), US Air Forces in Europe (USAFE), & Pacific Air Forces (PACAF) aircrew manning ratios are lower than those of ACC units, which does not allow them to sustain operations at the same Optempo. Therefore, warfighting CINCs will not receive the same sortie generation capability from non-ACC units.	ACC/DRS, 1995a, p. 36	

MOE/MOP	DEFINITION	REFERENCE	APPLICATION, EXAMPLE, FINDING
Sortie Generation Rate	Average # of sorties produced per aircraft during a defined period.	AFI 90-201/ACC SUP 1 (ACC/IGIX, 1996); AMCI 90-201 (AMC/IGPS, 1996); Cooper, 1996; Evans, 1996; JAST, 1995; MIL-STD-1776A, 1994, p. 54; AFI 10-602 (USAF/LGMM, 1994), p. 11	
Utilization (UTE) Rate	The average life units that pass per system during a specific period, expressed in flight hours or sorties per aircraft per relevant period of time, such as a day or month.	AFI 10-602 (USAF/LGMM, 1994); AMCPAM 21-102 (AMC/LGQA, 1995), p.19; AMC/XP, 1995, p. 1-24; AMC/XP, 1996, p. 1-24; Rau & Egbert, 1972; ACC/LGP, 1995, p. 36; PACAF/LGS (No Date) ; AETC/LGMM, 1996; ANGRC/LGMM, 1997; Chester, 1997; Pinkston, 1997	Average the flight hours or sorties during the period & divide by the average # of possessed aircraft (during peacetime) or authorized aircraft (during wartime).
Sortie UTE Rate	The average number of sorties (fighter aircraft) flown per authorized or chargeable aircraft per month.	ACC/LGP, 1995, p. 36; 1996; ANGRC/LGMM, 1997	(sorties flown) ÷ (authorized or chargeable aircraft)
Flying Hour UTE Rate	The average number of hours flown (all other aircraft ) per authorized or chargeable aircraft per month.	ACC/LGP, 1995, p. 36; 1996	(hours flown) ÷ (authorized or chargeable aircraft)
Objective UTE Rate	The average # of hours per day the primary aircraft inventory fly, & is measured over two periods: "surge" & "sustained."	AMC/XP, 1995, p. 1-23; AMC/XP, 1996, p. 1-23	Surge = the first 45 days of a contingency. Sustained = time after first 45 days.
Average UTE per Aircraft per Month	The average life units that pass per system during a month.	Rau & Egbert, 1972	
Adjusted Sortie Schedule(Adj. Sortie Sched.)	Sorties scheduled; includes outside factors.	Woehr & Miller, 1995; Woehr, 1996	local sorties scheduled + weather adds + ferry/FCF adds + other adds - weather deletes - sympathy deletes - other deletes
Sorties Scheduled	<i>self explanatory</i>	ANGRC/LGMM, 1997	
Sorties Flown	<i>self explanatory</i>	ANGRC/LGMM, 1997	
Sorties Scheduled vs. Flown	<i>self explanatory</i>	ANGRC/LGMM, 1997	(Sorties Scheduled) - (Sorties Flown)
Reaction Time	The time required to receive a mission request or message, process the data, & communicate the response.	Turner & Bard, 1972, p. 5	
Deployability	Whether the system can be efficiently be deployed to the theater of operations within the constraints of the user defined requirements.	AFI 10-602 (USAF/LGMM, 1994), p. 23; AFI 90-201/ACC SUP 1 (ACC/IGIX, 1996); Cooper, 1996	

MOE/MOP	DEFINITION	REFERENCE	APPLICATION, EXAMPLE, FINDING
Days to deploy to selected location		ACC Recommendations - EMAIL	
# of Aircraft Successfully Deployed	Scheduled Aircraft Arriving At Employment Base□	AFI 90-201/ACC SUP 1 (ACC/IGIX, 1996)	
Regeneration After Deployment	The deployed unit's ability to attain a combat ready posture for the in-theater commander as soon as possible after arriving at a deployment base.	AFI 90-201/ACC SUP 1 (ACC/IGIX, 1996)	
Percent of deployed equipment packed for shipment		ACC Recommendations - EMAIL	
Total personnel identified to redeploy		ACC Recommendations - EMAIL	
Reliability (system/mission)	The probability that an available system/mission will perform its required function at a specified mission time, in a specified environment, or during a scenario over the duration of a specified mission or over a specified # of sorties.	AFI 10-602 (USAF/LGMM, 1994), p. 11; AFI 90-201/ACC SUP 1 (ACC/IGIX, 1996); AFI 90-201/AFSOC SUP 1 (AFSOC/IG, 1995); AFOTEC/XRC, 1994, p. D-53; 1996; AMC/LGQP, 1996; MIL-STD-1776A, 1994, p. 54	Divide the # of missions completed successfully by the # of missions attempted (AFI 10-602 [USAF/LGMM, 1994]).
Cannibalization Rate (CANN)	Average # of CANNs actions per 100 sorties flown. (A CANN action is the removal of a part from an aircraft or engine to replace an unserviceable part on another aircraft or engine.)	ACC/LGP, 1995, p. 13; 1996; AMC/LGQP, 1996; Klarer, 1997; PACAF/LGS (No Date); AETC/LGMM, 1996; SEMR (No Date); ANGRC/LGMM, 1997; Chester, 1997; Pinkston, 1997	$[(\# \text{ of cannibalization actions}) \div (\text{total sorties flown})] \times 100$
# of CANNs	<i>self explanatory</i>	ANGRC/LGMM, 1997	
CANNs (Removals Only) Per Departure or Sortie	Average # of CANN removals (action taken T only) per departure or sortie.	AMCPAM 21-102 (AMC/LGQA, 1995), p. 13	$(\text{Total \# of cannibalizations}) \div (\# \text{ departures \& sorties})$
CANNs Per Average Possessed Aircraft	Average # of CANN removals (action taken T only) per average possessed aircraft (method used in LG summary & HOF briefing).	AMCPAM 21-102 (AMC/LGQA, 1995), p. 13	$(\text{Total \# of cannibalizations}) \div (\text{Average possessed aircraft})$
Average Hanger Queens	Aircraft that have not flown for at least 30 consecutive days.	ACC/LGP, 1995, p. 11	$(\text{Total Hanger Queen Days in Reporting period}) \div (\text{Days in Reporting period})$
Maintainability/Maintenance	The ability of an item to be retained in, or restored to, a specified condition within a given time period when maintenance is performed by personnel having specified skills using prescribed procedures & resources at each prescribed level of maintenance & repair.	ASC/XRG, 1996, p.4-92; AFI 90-201/AFSOC SUP 1 (AFSOC/IG, 1995); AFOTEC/XRC, 1994, p. D-53; 1996; AMCI 90-201 (AMC/IGPS, 1996); JAST, 1995; MIL-STD-1776A, 1994, p. 54; AFI 10-602 (USAF/LGMM, 1994), p. 9	

MOE/MOP	DEFINITION	REFERENCE	APPLICATION, EXAMPLE, FINDING
Sustainability	A system's ability to maintain the necessary level & duration of operations to achieve military objectives. Often measured in # of days.	SofTech, 1985, p. 2-2; AFI 10-602 (USAF/LGMM, 1994), p. 12	
Combat Rate	The average # of consecutively scheduled missions flown before aircraft experience critical failures.	AFI 10-602 (USAF/LGMM, 1994), p. 7	Divide the # of successful sorties flown by the # of scheduled missions minus # of ground aborts minus # of air aborts.
Commitment Rate	The % of possessed aircraft (C-130 aircraft only) that are committed (or scheduled) for use. This includes requirements for Headquarters tasked missions, mission spares, aircraft on alert, local missions, ground trainers, or static displays.	ACC/LGP, 1995, p. 14; 1996	$[(\text{total \# of committed aircraft}) \div (\text{cumulative possessed aircraft})] \times (100)$
Blockspeed	Calculated in nautical miles (NM) per hour (kt) & is the average ground speed from takeoff to block-in assuming a 2,500 NM average leg distance.	AMC/XP, 1995, p. 1-24; AMC/XP, 1996, p. 1-24	
Rate of Movement	Calculated in kilometers per hour (kph).	UNTL, 1996, p.183	
Distance Required to Move	Measured in NM.	UNTL, 1996, p. 183	
Rate of Movement	Calculated in kilometers per hour (kph).	UNTL, 1996, p. 183	
Distance Required to Move	Measured in NM.	UNTL, 1996, p. 183	
Time to Initiate Movement	Calculated in minutes/hours.	UNTL, 1996, p. 183	
Time to Complete Movement	Calculated in hours.	UNTL, 1996, p. 183	
Payload	Based on the average payload observed in the Mobility Readiness Study modeling process using a critical leg distance of 3,200 NM.	AMC/XP, 1995, p. 1-24; AMC/XP, 1996, p. 1-24	
Productivity Factor	A factor to account for the aircraft returning empty from the theater & positioning legs to onload locations. The productivity factor is constant at 47%.	AMC/XP, 1995, p. 1-24; AMC/XP, 1996, p. 1-24	

## AERONAUTICAL SYSTEM – HUMAN PERFORMANCE MOE/MOP TAXONOMY REFERENCES

- Adams, M.J., Tenney, & Pew, R.W. (1991). *Strategic workload and the cognitive management of advanced multi-task systems* (CSERIAC State of the Art Report [SOAR] 91-6). Wright-Patterson AFB, OH: CSERIAC.
- Aeronautical Systems Center (ASC/XRG). (1996). *Air-to-surface development plan*, 30 Sep 96. Wright-Patterson AFB, OH: Author.
- ASC (ASC/XRR). (1996). *The FY96 Air Force rescue mission area development plan*, 30 Sep 96. Wright-Patterson AFB, OH: Author.
- Air Combat Command (ACC/DRC). (1995a). *Air Force modernization planning: Strategic air defense mission area plan FY1996*, 15 Nov 95. Langley AFB, VA: Author.
- ACC (ACC/DRC). (1995b). *Air Force modernization planning: Theater battle management mission area plan FY1996*, 15 Nov 95. Langley AFB, VA: Author.
- ACC (ACC/DRS). (1995a). *Air Force modernization planning: Combat delivery mission area plan FY1996*, 15 Nov 95. Langley AFB, VA: Author.
- ACC (ACC/DRS). (1995b). *Air Force modernization planning: Combat rescue mission area plan FY1996*, 15 Nov 95. Langley AFB, VA: Author.
- ACC/IGIX. (1996). AFI 90-201/ACC SUP 1, *Inspector General Activities*, 1 Jan 96. Langley AFB, VA: Author.
- Air Education and Training Command (AETC/LGMM). (1996). AETC Instruction 21-105, *Logistics quality performance measures: Reporting procedures*, 28 May 96. Author.
- Air Force Material Command (AFMC/LGMM). (1994). AFI 21-103, *Equipment inventory, status, and utilization reporting*, 25 Jul 94. Wright-Patterson AFB, OH: Author.
- Air Force Operational Test and Evaluation Center (AFOTEC/XRC). (1991). *C-17 initial operational test and evaluation (IOT&E) Plan*, Dec 91. Kirtland AFB, NM: Author.
- Air Force Operations (AF/XOOOR, 1995). Status of Resources and Training System (SORTS), AFI 10-201. Washington, DC: Author.
- AFOTEC (AFOTEC/XRC). (1994). *V-22 operational assessment plan*, Apr 94. Kirtland AFB, NM: Author.
- AFOTEC (AFOTEC/XRX). (1994). AFI 99-102, *Operational test and evaluation*, 22 Jul 94. Kirtland AFB, NM: Author.
- Air Force Special Operations Command (AFSOC/IG). (1995). AFI 90-201/AFSOC SUP 1, *Inspector General*, 1 Dec 95. Hurlburt Field, FL: Author.
- Air Force Task List (AFTL) (AFDD 1-1). (1998). Washington, D.C.: Department of the Air Force.
- Air Mobility Command (AMC/LGQA). (1995). AMC Pamphlet (AMCPAM) 21-102, *Unit Health of the Force Reports and Maintenance Analysis Guide*, 18 Dec 95. Scott AFB, IL: Author.
- AMC (AMC/LGQP). (1996). *Health of the Force Briefing*. Scott AFB, IL: Author. [Online]. Available: <http://amclg.safb.af.mil/lgmain.html>
- AMC (AMC/XP). (1995). *1996 Air Mobility Master Plan (AMMP)*, 2 Oct 95. Scott AFB, IL: Author.
- AMC (AMC/XP). (1996). *1997 Air Mobility master plan (AMMP-97)*, 11 Oct 96. Scott AFB, IL: Author.
- AMC (AMC/IGPS). (1996). AMC Instruction (AMCI) 90-201, *The Inspection System*, 15 Sep 96. Scott AFB, IL: Author.
- Air National Guard Readiness Center (ANGRC/LGMM). (1997). *7401 Spreadsheet*. Personal communication with MSgt Girard, ANGRRC.
- Ball, R.E. (1985). *The fundamentals of aircraft combat survivability analysis and design*. AIAA Education Series.
- Battilega, J.A. & Grange, J.K. (eds.) (1984). The choices and uses of criteria. *The military applications of modeling*. Wright-Patterson AFB, OH: Air Force Institute of Technology (AFIT) Press, pp 38-62.
- Bornman, L.G. (1993). *Command and control measures of effectiveness handbook (C2MOE Handbook)*. (Technical Document TRAC-TD-0393). Fort Leavenworth, KS: TRADOC Analysis Command, Study and Analysis Center Study Directorate (ATRC-SAS).
- Chester, Lt Col. (1997). *SEMR* (briefing). HQ USAF/LGMY.

- Chairman of Joint Chiefs of Staff Manual. (1996). *Section 3: Conditions for Joint Tasks*. Department of Defense, Pentagon, Washington, D.C.
- Compendium of authenticated systems and logistics terms*. (1981). Wright-Patterson AFB, OH: AFIT School of Systems and Logistics. (DTIC No. AD-A100 655)
- Cooper, S. (1996). *JAST logistics modeling environment: MPTDSS*. Briefing presentation material. Presented 26 Jan 96.
- Department of Defense (DoD). (1994). Military Standard. *Aircrew Station and Passenger Accommodations* (MIL-STD 1776A). Washington, DC: Author.
- DoD. (1996). DoD 5000.2 - *Regulation*, 15 Mar 96. Washington, DC: Author.
- Dudley, J.R., & Novotny, M.J. (1994). *A methodology for establishing maximum aircraft combat turn rates* (Thesis). Wright-Patterson AFB, OH: AFIT. (DTIC No. AD-A285 000)
- Eisenhardt, R.G., Eisenhardt, G.H., & Douthat, D.Z. (1985). *Pilot's associate definition study*. Arlington, VA: Defense Advanced Research Projects Agency. (DTIC No. AD-A157 106)
- Evans, D.K. (1996). Bomb damage assessment and sortie requirements. *Military operations research, Vol2(1), Spring 1996*. Alexandria, VA: Military Operations Research Society. pp.31-35.
- Ford, M.W. (1994). *Air-to-air combat effectiveness of single-role and multi-role fighter forces*. (Thesis). Fort Leavenworth, KS: US Army Command and General Staff College. (DTIC No. AD-A284 587)
- GAO/NSIAD-96-86. (1996). *Air Force maintenance: Two level maintenance program assessment*, 27 Mar 96. Washington, DC: Author.
- GAO/NSIAD-96-194. (1996). *Military readiness: Data and trends for April 1995 to March 1996*, 2 Aug 96. Washington, DC: Author.
- GAO/Program Evaluation and Methodology Division (PEMD)-96-10. (1996). *Operation Desert Storm: Evaluation of the air war*. Washington, DC: Author.
- Gayman, A., Schopper, A.W., Wourms, D.F., & Moroney, W.F. (1995). *Situation awareness in tactical aircraft: Electronic warfare implications*. (CSERIAC-RA-95-002). Wright-Patterson AFB, OH: CSERIAC. (DTIC No. AD-B206 861)
- HQ USAF/XOOT. (1997). *Air Force Task List at the Tactical Level of War*. Pentagon, Washington, D.C. [Online]. Available: [http://www.hq.af.mil/xo/xoot/HQ\\_USAF/XOOTv1.html](http://www.hq.af.mil/xo/xoot/HQ_USAF/XOOTv1.html)
- Johnson, R. (1996). Bombs away: Exercise links aircrews, ammo troops to put bombs on target. *Airman, July 1996*.
- Joint Advanced Strike Technology (JAST) Program. (1995). *JAST operations analysis study plan: Revision I*. April 1995: Author.
- Klarer, J.J. (1997). *USAFE Weapons Systems Review for Jan 97*. US Air Forces in Europe.
- Lehman, E.F., & Jenkins, M.L. (1990). *Handbook for conducting pilot-in-the-loop simulation for crew station evaluation* (HSD-TR-90-007). Dayton, OH: Veda Inc.
- Lehman, E.F., Peio, K.J., Masters, R.M., & Bloomfield, J.R. (1989). *Candidate measures of merit for the evaluation of aircrew decision making* (63717-89U/P6754). Wright-Patterson AFB, OH: Air Force Systems Command.
- McMillan, G.R., Beevis, D., Stein, W., Strub, M.H., Salas, E., Sutton, R., & Reynolds, K.C. (1991). *A directory of human performance models for system design* (Report No. AC/243 (Panel 8) TR/1). Wright-Patterson AFB, OH: Armstrong Laboratory, Human Engineering Division. (DTIC No. AD-A247 346)
- Pacific Air Forces (PACAF/LGS). (No Date). *Logistics Metric Handbook*. Hickam AFB, HI: Author. [Online]. Available: <http://www.hqpacaf.af.mil/lg/lgs/metrics.htm>
- Pinkston, D. (1997). *SEMR* (briefing). Synergy, Inc.
- Rau, J.G. & Egbert, R.J. (1972). *A study of measures of effectiveness used in Naval analysis studies*, Vol. 1. Office of Naval Research, Naval Analysis Programs. (DTIC No. AD-A912 443)
- Rehmann, A.J. (1995). *Handbook of human performance measures and crew requirement for flightdeck research*. (DOT/FAA/CT-TN9/49). Atlantic City Airport, NJ: FAA Technical Center.

- SofTech, Inc. (1985). Air Force Integrated Readiness Measurement Systems (AFIRMS): Analysis of Military Airlift Command (MAC) Capability Assessment Metrics. Alexandria, VA: Author. (DTIC No. AD-A170 523)
- Sustainment Executive Management Report (SEMR). (No Date). Washington, DC: Synergy, Inc.
- Turner, C.R., & Bard, J.F. (1972). Tactical AWACS measures of effectiveness. L.G. Hanscom Field, Bedford, MA: Air Force Systems Command, Electronic Systems Division. (DTIC No. AD-A742 233)
- United States Air Force (USAF/LGMM). (1994). Air Force Instruction (AFI) 10-602, Determining Logistics Support And Readiness Requirements, 20 Jun 94. Washington, DC: Author.
- USAF (USAF/LGMM). (1996). AFI 21-101, Maintenance management of aircraft, 1 Oct 96. Washington, DC: Author.
- USAF (USAF/LGMW). (1993). AFD 21-2, Nonnuclear and nuclear munitions, 8 Jun 93. Washington, DC: Author.
- United States Air Forces in Europe (USAFE/LGP). (1997). USAFE/LG functional metrics, 6 Jan 97. Author.
- Universal Joint Task List (UJTL) - Version3.0 (CJCSM 3500.04A). (1996). Andover, MA: Dynamics Research Corporation. (13 Sep 96).
- Universal naval task list (UNTL) - Section 5: Measures for joint and naval tasks (OPNAVINST 3500.38). (1996). Manuscript in press.
- Vidulich, M. (1994). Cognitive and performance components of situation awareness: SAINT team task one report. In Vidulich, M., Dominguez, C., Vogel, E., & McMillian, G. (Eds.), Situation awareness: Papers and annotated bibliography. (Report No. AL/CF-TR-1994-0085, pp. 17-28). Wright-Patterson AFB, OH: Armstrong Laboratory, Crew Systems Directorate.
- Vidulich, M., Dominguez, C., Vogel, E., & McMillian, G. (Eds.) (1994). Situation awareness: Papers and annotated bibliography. (Report No. AL/CF-TR-1994-0085). Wright-Patterson AFB, OH: Armstrong Laboratory, Crew Systems Directorate.
- Vogel, E. (1994). SA: An operational point of view. In Vidulich, M., Dominguez, C., Vogel, E., & McMillian, G. (Eds.), Situation awareness: Papers and annotated bibliography. (Report No. AL/CF-TR-1994-0085, pp. 17-28). Wright-Patterson AFB, OH: Armstrong Laboratory, Crew Systems Directorate.
- Woehr, D.J., & Miller, M.J. (1995). Distribution-based evaluation and assessment of mission readiness for the evaluation of personnel training. College Station, TX: Texas A&M University.
- Woehr, D. (1996). Distribution-based evaluation and assessment of mission readiness. College Station, TX: Texas A&M University.

## APPENDIX C, Aircraft System Maintenance/Supportability MOEs/MOPs

(Source: AFI 10-602 [USAF/LGMM, 1994])

**1.0 Availability and Sustainability.** MAJCOMs must consider the availability and sustainability measures when describing top-level logistics requirements for aircraft systems. Use the equations below to develop these measures.

**1.1 Mission-Capable (MC) Rate.** Use the MC rate to measure how long, in percent of possessed time, a system can perform at least one of its assigned missions.

1.1.1 Base the MC rate on the sum of the fully mission capable (FMC) and partially mission capable (PMC) rates. Express this calculation as:

$$MC = FMC + PMC$$

1.1.2 The overall MC requirement describes different design missions, the expected percentages of equipment use, and the desired MC rate for each mission.

1.1.3 The overall MC requirement describes different design missions, the expected percentages of equipment use, and the desired MC rate for each mission.

1.1.4 PMC status indicates that an aircraft can perform at least one of its assigned missions. You may report a multi-mission aircraft as PMC even if it is unable to accomplish its primary mission.

1.1.5 MC rate has some limitations. It varies with use during a given calendar period of time so that the more a system operates, the more it goes down for corrective and preventive maintenance. MC rate doesn't accurately account for preventive maintenance efforts.

**1.2 Utilization Rate (UR).** Use UR to measure the average life units that pass per system during a specific period.

1.2.1 Express UR as flight hours or sorties per aircraft per relevant period of time, such as a day or month. Calculate the value by averaging the flight hours or sorties during the measurement period and dividing this figure by the average number of possessed aircraft (during peacetime) or authorized aircraft (during wartime). Express this calculation as:

$$\text{Daily Wartime Sortie UR} = \frac{\text{Average number of sorties per day}}{\text{Average number of aircraft authorized}}$$

1.2.2 Establish required or planned peacetime and wartime UR values.

**1.3 Essential System Repair Time per Flight Hour (ESRT/FH).** Use ESRT/FH to compare clock time needed to repair mission-essential equipment and operating time measured in flying hours.

1.3.1 ESRT/FH addresses both corrective maintenance (CM) and preventive maintenance (PM) performed on mission-essential equipment. This measurement pertains only to full system list (FSL) equipment. Express this calculation as:

$$ESRT / FH = \frac{\text{Elapsed PM} + \text{Elapsed CM}}{\text{Flight Hours}}$$

**2.0 Mission Reliability.** MAJCOMs must consider mission reliability measures to describe top-level logistics requirements for aircraft systems.

**2.1 Weapon System Reliability (WSR).** Use WSR to measure the probability that a system with a record of completing a specified mission will continue to do so.

2.1.1 Compute the value of WSR by dividing the number of missions completed successfully by the number of missions attempted.

2.1.2 Define "mission" in terms of start-to-finish criteria. Factor in the effect of crew changes. Relate the success of the mission to the satisfactory performance of mission-essential items during the mission.

- 2.1.3 Base WSR on a mission design reference profile to allow for translation of WSR into contractual requirements.
- 2.1.4 Determine functional profiles for storage, build-up, preflight, takeoff, ingress, over-target, weapons delivery, egress, landing, and shutdown. Determine environmental profiles such as temperature, air density, humidity, vibration, shock, corrosive agents. Determine mission critical systems for these profiles.
- 2.1.5 Establish a single peacetime and wartime WSR value for each given mission.  
**EXCEPTION:** If the peacetime mission length differs significantly from the wartime mission length, establish two values for WSR. Where you specify more than one type of mission, give the percentage of time over which you intend to use the equipment and the desired WSR for each mission.

**2.2 Break Rate.** Use break rate to measure the percentage of sorties from which an aircraft returns with an inoperable mission-essential system that was previously operable. Break rate includes “code 3” conditions, such as ground and air aborts.

- 2.2.1 Measure the break rate by dividing the number of missions flown by the number of “code 3” events. Express this calculation as:

$$\text{Break rate (\%)} = \frac{\text{Number of aircraft breaks during measurement period}}{\text{Number of sorties flown during period}} \times 100$$

**2.3 Combat Rate.** Use the combat rate to measure the average number of consecutively scheduled missions flown before aircraft experience critical failures.

- 2.3.1 Combat rate reflects the philosophy that scheduling and completing a mission is more important than changing it mid-flight because of equipment failures. Express this measure of mission reliability as:

$$\text{Combat Rate} = \frac{\text{Number of successful sorties flown}}{\text{Number of Scheduled missions - Number of ground aborts} - \text{Number of air aborts}}$$

**2.4 Mean Time Between Critical Failure (MTBCF).** Use MTBCF to measure the average time between failures of mission-essential system functions.

- 2.4.1 Critical failures occur when mission essential systems become inoperable or operate outside their specified range of performance. MTBCF includes all hardware and software critical failures that occur during mission and non-mission time. Express MTBCF as:

$$\text{MTBCF} = \frac{\text{Number of operating hours}}{\text{Number of critical failures}}$$

**3.0 Logistics Reliability.** MAJCOMs must consider logistics reliability measures when describing top-level logistic requirements for aircraft systems.

**3.1 Mean Time Between Maintenance (MTBM).** Use MTBM to measure the average life units between maintenance events, including scheduled and unscheduled events.

- 3.1.1 Use flying hours as the life units for aircraft. Select an appropriate MTBM parameter based on MAJCOM requirements. Current and planned information systems permit tracking of standard MTBM parameters, such as:

- MTBM (inherent malfunctions)
- MTBM (induced malfunctions)
- MTBM (no-defect events)
- MTBM (total corrective events)
- MTBM (preventive maintenance)

- MTBR (mean time between removal for cause)
- MTBD (mean time between demand)

3.1.2 Specify peacetime and wartime values for MTBM, since equipment used during these periods may differ.

**4.0 Maintainability.** MAJCOMs must consider maintainability measures when describing top-level logistics requirements for aircraft systems.

**4.1 Mean Downtime (MDT).** Use MDT to measure the average elapsed time between losing MC status and restoring the system to MC status.

4.1.1 MDT quantifies the clock time required to return the system to at least PMC status.

Downtime includes:

- On-equipment (and in some instances off-equipment) repair labor time
- Non-labor time, such as cure time for composites
- Maintenance and supply response time
- Administrative delays
- Time for other activities that result in NMC status such as:
- Training
- Preventive maintenance

4.1.2 MDT also takes into account field conditions, such as:

- Technical order (TO) availability and adequacy
- Support equipment capability
- Availability, supply levels, and manning (including experience level and structure of duty shifts)

4.1.3 MDT mainly addresses unscheduled maintenance, but it can also include scheduled maintenance, such as scheduled inspections. Develop a single peacetime and wartime value for MDT. **EXCEPTION:** When you expect maintenance or support conditions in wartime to differ significantly from those in peacetime, describe those differences and describe separate values for MDT.

**4.2 Fix Rate.** Use fix rate to calculate the percentage of aircraft that return as “code 3” and must be returned to MC status within a specified amount of time (for example, 70 percent in 4 hours or 85 percent in 8 hours).

4.2.1 The time requirement for fix rate includes direct maintenance time and downtime associated with administrative and logistics delays. Express fix rate as:

$$\text{Fix Rate} = \frac{\text{Number of aircraft fixed within "X" hours}}{\text{Total number of broken aircraft}}$$

**4.3 Mean Repair Time (MRT).** Use MRT to measure the average on-equipment or off-equipment corrective maintenance time in an operational environment. State MRT requirements for on-equipment at the system level and for off-equipment at the line replaceable unit (LRU) level.

4.3.1 MRT starts when the technician arrives at the aircraft site for on-equipment maintenance or receives the LRU at the off-equipment repair location. MRT includes all necessary corrective maintenance actions, such as:

- Test preparation
- Troubleshooting
- Removing and replacing parts
- Repairing
- Adjusting
- Checking functions
- Curing

**EXCEPTION:** Don't include maintenance or supply delays in MRT calculations.

4.3.2 Express MRT as:

$$\text{MRT (on - equipment)} = \frac{\text{Total on - equipment corrective maintenance time}}{\text{Total number of on - equipment maintenance events}}$$

$$\text{MRT (off - equipment)} = \frac{\text{Total off - equipment corrective maintenance time}}{\text{Total number of off - equipment maintenance events}}$$

**5.0 Manpower.** MAJCOMs must consider manpower measures when describing top-level logistics requirements for aircraft systems.

**5.1 Maintenance Man-Hours per Life Unit (MMH/LU).** MAJCOMs base maintenance man-hours per flying hour (MMH/FH) on their specific needs. Current and planned maintenance information systems permit tracking:

- MMH/FH support, general
- MMH/FH corrective, for inherent malfunctions, induced malfunctions, no-defect actions, or total events
- MMH/FH product improvement
- MMH/FH preventive maintenance (time change items)
- MMH/FH, all categories totaled

5.1.1 Specify MMH/FH peacetime and wartime value, since equipment usage, maintenance needs, and support concepts may differ during these periods.

**5.2 Maintenance Personnel per Operational Unit (MP/U).** Use MP/U to measure the total number of direct maintenance personnel needed for each specified operational unit to perform direct on-equipment and off-equipment maintenance. Develop manpower projections to support specified operating and maintenance concepts, taking into consideration basing, deployment, and operational scenarios.

5.2.1 MP/U calculations include direct on-equipment and off-equipment maintenance personnel and specialties related to direct on-equipment and off-equipment support, such as structural repair (including sheet metal and composites) and nondestructive inspection. When analyzing manpower requirements, MAJCOMs should consider and use projected MC, PMC, MRT, and MTBM rates, coupled with aircraft battle damage repair analyses to determine overall manpower needs.

5.2.2 MP/U calculations exclude:

- Unit deputy chief of maintenance staff agencies
- Command section operations and support personnel
- Powered support equipment (SE) support personnel
- Munitions supply and missile maintenance personnel

**6.0 Deployability.** MAJCOMs must take into account deployability considerations in describing top-level requirements for aircraft systems. Address:

- Whether the system can be deployed to the theater of operations within the constraints of the user defined requirements.

- Maintenance planning factors:
  - Manpower
  - Interoperability
  - Compatibility
  - Environmental concerns
  - Safety
  - Maintenance facilities
  - Depot support
- 6.1 **Deployment Footprint.** A system's deployment footprint defines the manpower, materiel, and equipment required to initially support the design reference mission profile under peacetime, wartime, or other contingency operations outside the primary operating location for the designed system. As a basis of measure, use, for example, equivalent pallet positions.
- 6.2 **Logistics Support Tail.** A system's logistics support tail defines the manpower, materiel, and equipment required to sustain the design reference mission profile under peacetime, wartime, or other contingency operations outside the primary operating location for the designed system. Logistics support requirements must account for all manpower, materiel, and equipment directly or indirectly associated with the weapon system under consideration. For example, low reliable, mission critical systems require high levels of support (manpower and supplies) to sustain the mission over a given period of time.

**APPENDIX D, Comparison of MAJCOM and Air Staff Maintenance-related Metrics**  
(in alphabetical order)

<b>Metric</b>	<b>ACC</b>	<b>AETC</b>	<b>AFSOC</b>	<b>AMC</b>	<b>ANG</b>	<b>PACAF</b>	<b>USAFE</b>	<b>Air Staff</b>	<b>SEMR</b>
# of Air Aborts					√				
# of CANNs					√				
# of Ground Aborts					√				
# of Recurs					√				
# of Repeats					√				
Adherence to Directives						√		√	
Aerospace Ground Equipment MC Rate						√			
Air Abort Rate	√	√		√		√			
Air Refueling	√		√	√					
Aircraft Battle Damage Repair Time			√						
Aircraft Forms Status								√	
Aircraft Mission Supportability								√	
Aircraft Possessed Hours				√	√				
Aircrew Munitions Expenditures						√			
Airdrop Accuracy	√		√	√					
Assessments, Evaluations, & Inspections (Overall Pass Rate)						√			
Attrition Factor (Rate)		√		√					
Availability								√	
Average Possessed Aircraft	√	√		√	√		√		

Metric	ACC	AETC	AFSOC	AMC	ANG	PACAF	USAFE	Air Staff	SEMR
Average Sortie Duration	√			√					
Bench Stock Availability Rate		√				√			
Break Rate	√	√		√	√	√	√	√	√
Cancellation Rate				√					
Cannibalization (CANN) Rate	√	√		√		√	√		√
Cannot Duplicate						√			
CANNs (Removals Only) Per Departure or Sortie				√					
CANNs Per Average Possessed Aircraft				√					
Combat Rate								√	
Critical Test Equipment						√			
Deferred Discrepancy Rate	√	√				√			
Deferred Maintenance - Awaiting Maintenance/Parts (AWM/AWP)					√	√			
Delayed Discrepancy Average				√	√	√			
Delayed Discrepancy Rate	√	√		√		√			
Delayed Take-Offs (due to fuels)						√			
Deployability	√							√	
Dropped Object Rate				√		√			
Due-In Record Not Loaded						√			
Electronic Warfare Pods MC Rate	√					√			
Engine Flow Time						√			

Metric	ACC	AETC	AFSOC	AMC	ANG	PACAF	USAFE	Air Staff	SEMR
Engine Foreign Object Damage Rate				√		√			
Engine NMC Supply						√			√
Engine Preparation for Shipment						√			
Equipment In-Commission Rate							√		
Essential System Repair Time per Flight Hour								√	
Excess Inventory						√			
Facilities Condition						√			
FH Allocated vs. Flown					√				
FH Flown					√				
FH Scheduled					√				
FH Scheduled vs. Flown					√				
Fill Rate							√		√
Fix Rate	√	√		√	√	√		√	
Fleet Availability				√					√
Flying Hours (FH) Allocated					√				
Fully MC Rate	√	√		√	√	√	√	√	
General Purpose VIC Rate							√		
Gold Flag Repair Opportunities						√			
Ground Abort Rate	√	√		√		√			
Gun Reliability Rate						√			
Impoundments						√			
Inventory Accuracy Rate						√			

Metric	ACC	AETC	AFSOC	AMC	ANG	PACAF	USAFE	Air Staff	SEMR
Issue Process						√			
Maintainability/Maintenance			√	√				√	
Maintenance Delivery Reliability				√					
Maintenance Flying Scheduling Effectiveness Rate		√						√	
Maintenance Man-Hours (MMH) per Life Unit								√	
Maintenance Personnel per Operational Unit								√	
Maintenance Plan Scheduling Effectiveness Rate	√	√				√		√	
Maintenance Related In-flight Emergency Rate						√		√	
Maintenance Related On-duty Ground Mishaps						√		√	
Maintenance Turn Time/Turn Around Time								√	
Mean Down Time								√	√
Mean Repair Time								√	
Mean Time Between Critical Failure				√				√	√
Mean Time Between Failure (MTBF)									√
Mean Time Between Maintenance Actions					√			√	
Mean Time Between Removals								√	
Mean Time to Repair								√	
Mission Capable (MC) Rate	√	√		√	√	√	√	√	√

Metric	ACC	AETC	AFSOC	AMC	ANG	PACAF	USAFE	Air Staff	SEMR
MMH per Flying Hour				√				√	
MMH/FH - Corrective								√	
MMH/FH - Improvement								√	
MMH/FH - Preventive								√	
MMH/FH - Support	√							√	
Munitions Inventory Accuracy						√			
NMC Both				√				√	
NMC Both Unscheduled Rate		√			√				
NMC Maintenance				√				√	√
NMC Maintenance Scheduled Rate		√			√				
NMC Maintenance Unscheduled Rate		√			√				
NMC Supply Rate		√		√	√			√	
Not Mission Capable (NMC) Rate				√				√	
Overall Vehicle In-Commission (VIC) Rate							√		
Partially MC (PMC) Rate				√				√	
PMC Both		√			√				
PMC Maintenance		√			√				
PMC Supply		√			√				
Possessed Availability				√	√				√
Priority Delivery Time						√			
Qualified Personnel								√	
Receiving - munitions						√			

Metric	ACC	AETC	AFSOC	AMC	ANG	PACAF	USAFE	Air Staff	SEMR
Receiving - Supply						√			
Record Accuracy						√			
Recur Rate	√				√	√	√	√	
Reliability (system/mission)	√		√	√				√	
Repeat Rate	√				√	√	√	√	
Repeat/Recur Rate	√					√	√		
Scheduled MMH					√				
Sortie Generation Rate	√			√				√	
Sortie UTE Rate	√				√				
Sorties Flown					√				
Sorties Scheduled					√				
Sorties Scheduled vs. Flown					√				
Spare Engine Level						√	√		√
Special Purpose VIC Rate							√		
Status of Training (SORTS)						√			√
Storage Process						√			
Supply Issue Effectiveness Rate	√	√				√	√		√
Sustainability								√	
System Capability Rate				√					
System Code 3 Status					√			√	
System Reliability Rate				√		√			
System Reliability Rate				√		√			
Time Left to Phase					√	√			
Time Over Target	√		√	√					
TNMC Maintenance	√	√			√	√	√		

Metric	ACC	AETC	AFSOC	AMC	ANG	PACAF	USAFE	Air Staff	SEMR
Total Abort Rate	√			√		√	√		
Total Cost per FH					√				
Total Failures					√				
Total NMC (TNMC) Supply	√	√			√	√	√		√
Total PMC (TPMC) Maintenance					√				
Total Repair Cycle Time						√			
TPMC Supply					√				
Trained Technicians						√			
Unscheduled Engine Removals					√	√			
Unscheduled MMH					√				
Utilization (UTE) Rate	√	√		√	√	√		√	√
Weapon System Reliability								√	
Weapons Load Crew Certification						√			
Weapons Release Reliability Rate						√			

## APPENDIX E, MOEs/MOPs and SORTS

SORTS Areas	SORTS Items	MOEs/MOPs
<b><i>Supply</i></b> - compare available supplies to required supplies (Junor & Oi, 1996).		
Personnel Quality	Intelligence/skill of personnel	
Manning	# personnel needed to complete task	
Equipment Failure Rate	# of supplies/spare/personnel needed to repair equipment	Break Rate
Weapons Procurement		
Spares	% of spare on hand	
Supply	% of possessed aircraft/% of aircraft mission ready and available	
<b><i>Equipment</i></b> - probability that a piece of equipment can be operated at any time; failure vs. repair (Junor & Oi, 1996).		Maintainability/Maintenance
<b><i>Failure Rate</i></b>		Break Rate
Personnel Quality	Intelligence/skill of personnel	
Manning	# personnel needed to complete task	MP/U
Deployment Cycle	Sorties/Flying Hours - enter number of sorties, durations, and rates the unit is required to perform for its wartime mission(s).	Deployability
Overhaul Cycle	The average time between failures of mission-essential system functions.	MTBCF
Modernization		
Age		
<b><i>Repair Rate</i></b>		Fix Rate
Personnel Quality	Intelligence/skill of personnel	MP/U
Manning	# personnel needed to complete task	Break Rate
Equipment Failure Rate	% of spare on hand	
Spares	The average time between failures of mission-essential system functions.	MTBCF/MRT/Maintenance Turn Time
Overhaul Cycle		
Modernization		
Deployment Cycle	Sorties/Flying Hours - enter number of sorties, durations, and rates the unit is required to perform for its wartime mission(s).	Deployability

SORTS Areas	SORTS Items	MOEs/MOPs
Age		
<b>Personnel</b> - compare available personnel to required personnel (Junor & Oi, 1996).		
Personnel Quality	Intelligence/skill of personnel	ASVAB/AFQT
Manning	# personnel needed to complete task	
Deployed Status	Response time - shortest time in hours (01-72 hours) in which unit must be able to respond (AFI 10-201, 1995).	Deployability
<b>Training</b> - depends on all other resource areas; to accomplish training, you need supplies, equipment, & personnel (Junor & Oi, 1996).		
Personnel Quality	Intelligence/skill of personnel	
Manning	# personnel needed to complete task	
Supply	% of possessed aircraft/% of aircraft mission ready and available	
Equipment		
Deployment Cycle	Sorties/Flying Hours - enter number of sorties, durations, and rates the unit is required to perform for its wartime mission(s).	Deployability
Time		

This page intentionally left blank.

## APPENDIX F, Sources of MOEs/MOPs

	EXERCISES	
Description	MOEs/MOPs	Surrogate Measures
<b>Blue Flag</b> - one of the largest air-power computer-assisted modeling and simulation exercises in the world (AFNS, 1995c; AFNS, 1996a).		
<b>Red Flag</b> - A realistic training operation conducted at Nellis AFB, NV. A variety of units deploy & participate in an assortment of air-to-air & air-to-ground scenarios against air & surface threats ( <i>Red Flag</i> , 1992; Rusing, 1980).	<ul style="list-style-type: none"> <li>• <b>Probability of Kill</b></li> <li>• <b>Bombs on Target</b></li> </ul>	
<b>Bright Star</b> - A training exercise designed to improve readiness & interoperability between U.S., Egyptian, French, British & United Arab emirates armed forces (AFNS, 1995a).		
<b>Cope North</b> - A series of exercises designed to enhance air operations in the defense of Japan (AFNS, 1995b).		
<b>Nimble Dancer</b> - A computer-based model used to assess ability of programmed U.S. forces to fight & win two nearly simultaneous major regional conflicts (MRCs) in 1997, 2001, & 2005 time frames & to identify critical issues related to the two-MRC requirement (GAO/NSIAD-96-170, 1996).		<ul style="list-style-type: none"> <li>• <b>Level of Risk</b></li> <li>• <b>Forward Line of Troops</b></li> <li>• <b>Days to Complete Battle</b></li> <li>• <b>Buildup</b></li> <li>• <b>Counterattack</b></li> <li>• <b>Territory Lost</b></li> <li>• <b>Territory Gained</b></li> </ul>
<b>CAPEX</b> - An exercise that provides realistic wartime training in bomb building and bombs on target (Johnson, 1996).	<ul style="list-style-type: none"> <li>• <b>Bomb-to-Target Ratio</b></li> <li>• <b>Bombs Built</b></li> </ul>	
<b>Global Yankee</b> - A joint exercise utilizing air, ground, & maritime forces for Joint Forces Command & Control (JFCC) training (ANGRC/XO, 1996).		

	EXERCISES	
Description	MOEs/MOPs	Surrogate Measures
<b>MARS</b> - used to evaluate the effects of new or existing platforms, weapons, or system capabilities, as well as command & control concepts, in the context of multiple platform engagement level analysis (Dauer, personal communication, July 19, 1996).		
<b>BATMAN &amp; ROBIN</b> - a computer-based wargame simulation developed to assess how well military personnel can allocate, deploy, & manage air, surface, &/or subsurface tactical assets during simulated battles in many warfare areas (Kabanek, 1991).	<ul style="list-style-type: none"> <li>• <b>Deployability/Mission Prep Time</b></li> <li>• <b># of targets found/total targets</b></li> <li>• <b># of targets killed/total targets</b></li> <li>• <b># of red kills per blue platform</b></li> <li>• <b># of blue kills per red platform</b></li> <li>• <b># of Misses</b></li> <li>• <b>Airdrop accuracy</b></li> <li>• <b>Pilot workload</b></li> </ul>	<ul style="list-style-type: none"> <li>• <b>Average range detected</b> - average range at which Red threats detected by Blue Forces.</li> <li>• <b>Average range destroyed</b> - average range at which Red threats destroyed by Blue Forces.</li> <li>• <b>% Missiles detected</b> - %age of anti-ship missiles detected by Blue Forces</li> <li>• <b>% Missiles destroyed</b> - %age of anti-ship missiles destroyed by Blue Forces</li> <li>• <b>%age of Kills</b> - %age of kills by Blue Forces (wins) &amp;/or by Red Forces (losses)</li> </ul>
<b>Air Force Commander</b> - commercial wargame designed to simulate air warfare in the Middle East (Goehring, 1993).		
<b>Conflict: Korea</b> - commercial wargame designed to simulate war in Korea (Goehring, 1993).		
<b>TAC BRAWLER</b> - designed to simulate air-to-air combat between multiple flights of aircraft in both visual and beyond-visual range (BVR) arenas (JAST, 1995, & SURVIAC, 1994).	<ul style="list-style-type: none"> <li>• <b># of red kills per blue platform</b></li> <li>• <b># of blue kills per blue platform</b></li> <li>• <b># of targets killed</b></li> <li>• <b>Total targets</b></li> </ul>	
<b>LCOM</b> - main use in the AF has been in the modeling of aircraft maintenance activities (Clark, 1989).	<ul style="list-style-type: none"> <li>• <b>Maintainability/Maintenance</b></li> <li>• <b>Sortie generation</b></li> </ul>	
<b>Enhanced Surface-to-Air Missile Simulation (ESAMS)</b> - Generates one-on-one probabilities of kill for BLUE aircraft vs. RED SAMs. (JAST, 1995).	<ul style="list-style-type: none"> <li>• <b>SAM engagements</b></li> <li>• <b>Survivability</b></li> <li>• <b># of blue kills per red platform</b></li> <li>• <b>Kills/Missile Fired</b></li> </ul>	

	EXERCISES	
Description	MOEs/MOPs	Surrogate Measures
<b>Extended Air Defense Simulation (EADSIM)</b> - Evaluates effectiveness & efficiency of weapon systems against targets & evaluates the value of different mixes of forces & resources (JAST, 1995).		
<b>THUNDER</b> - Two-sided, theater-level model designed to simulate conventional air-land combat. (JAST, 1995).	<ul style="list-style-type: none"> <li>• <b>Cost/kill</b></li> <li>• <b>Time to halt enemy advance</b></li> <li>• <b>Time to gain air superiority</b></li> </ul>	
<b>RADGUNS</b> - Simulation that evaluates the effectiveness of AAA systems against penetrating aerial targets and the effectiveness of different airborne target characteristics against specific AAA systems (JAST, 1995).	<ul style="list-style-type: none"> <li>• <b>AAA engagements</b></li> </ul>	
<b>SUPPRESSOR</b> - A simulation used to evaluate different weapon systems, sensor systems, tactics, & command procedures in composite electronic combat missions against an integrated air-defense (JAST, 1995).		

	COMPETITIONS	
Description	MOEs/MOPs	Surrogate Measures
<b>William Tell</b> - ACC competition where pilots, weapons directors, load crews, and maintenance teams are given the opportunity to display individual and team/element ability in a mix of events covering four separate mission profiles and concurrently run "loadéo" and maintenance competitions (ACC/DOOO, 1996).	<ul style="list-style-type: none"> <li>• Engagement times</li> <li>• Kills per sortie</li> <li>• Radar missile lock times</li> <li>• Missile miss distance</li> <li>• Fratricide</li> <li>• Serviceability</li> </ul>	<ul style="list-style-type: none"> <li>• Equipment condition</li> <li>• Ramp condition (cleanliness)</li> <li>• Late &amp; early takeoffs</li> <li>• Spare parts on-hand</li> </ul>
<b>GUNSMOKE</b> - MAJCOM composite force employment competition between teams sponsored by ACC, USAF - Europe, Pacific Air Forces, AETC, ANG, & AFRES. Emphasis is on enhancement of teamwork through composite force planning, short-notice execution, & competition losses ( <i>GUNSMOKE History</i> , 1995).	<ul style="list-style-type: none"> <li>• Bombs on target by Blue</li> <li>• Red kills by Blue</li> <li>• Blue kills by Red</li> <li>• Fratricide</li> <li>• Bombs on target by Red</li> </ul>	<ul style="list-style-type: none"> <li>• Direct hits of fragged targets</li> </ul>
<b>Long Shot</b> - Sponsored by ACC; mixed-force long-range bombing competition to test the integration of bomber and fighter aircraft that perform conventional missions (AFNS, 1996b).	<ul style="list-style-type: none"> <li>• Bombs on time</li> <li>• Bombs on target</li> <li>• # of Blue Kills</li> </ul>	
<b>RODEO</b> - U.S. Transportation Command's tanker/airlift competition. Tests the flight & ground skills of aircrews as well as the related skills of combat control, security police, aerial port, aeromedical evacuation, & maintenance team members (AMC/PA, 1996).	<ul style="list-style-type: none"> <li>• Airdrop accuracy/ Airdrops</li> <li>• Aircrew "alert times" on threat/Single Integrated Operations Plan (SIOP)</li> <li>• Maintainability/Maintenance</li> </ul>	<ul style="list-style-type: none"> <li>• <b>Aerial Refueling:</b> Receiving &amp; off- loading aircraft on timing &amp; accuracy in navigating to air refueling point.</li> <li>• <b>Shortfield Landings:</b> Ability to land on short airfields.</li> <li>• <b>Aircraft Navigation:</b> Navigation skills tested during aerial refueling mission using no more than three radar fixes.</li> <li>• <b>Combat Control:</b> Combat &amp; technical skills acquired through day-to-day duties &amp; unit training.</li> </ul>

## **APPENDIX G, Aircrew-System MOE/MOP Taxonomy**

Number	MOP/MOE	Definition (if needed)	Criteria (if needed)	Reference
<b>1</b>	<b>ATTAIN AND MAINTAIN AIR AND SPACE SUPERIORITY (AFT 1)</b>			
M 1.1	Degree of air and space superiority achieved			AFT1, M1 (AFDD 1-1, Aug 98)
M 1.2	Percent of air and space controlled			AFT1, M2 (AFDD 1-1, Aug 98)
M 1.3	Percent of friendly land, sea, air, & space forces that enjoy freedom of maneuver.			AFT1, M3 (AFDD 1-1, Aug 98)
M 1.4	Percent of enemy aircraft, missile, and air defense artillery threats countered.			AFT1, M4 (AFDD 1-1, Aug 98)
<b>1.1</b>	<b>Provide offensive and defensive counter-air (OCA and DCA) (AFT 1.1)</b>			
M 1.1.1	Percent of forces organized for the conduct of prompt and sustained combat operations in the air			AFT1.1, M1 (AFDD 1-1, Aug 98)
M 1.1.2	Percent of forces equipped for the conduct of prompt and sustained combat operations in the air			AFT1.1, M2 (AFDD 1-1, Aug 98)
M 1.1.3	Percent of forces trained for the conduct of prompt and sustained combat operations in the air.			AFT1.1, M3 (AFDD 1-1, Aug 98)
M 1.1.4	Percent of requested forces provided for combat operations in the air.			AFT1.1, M3 (AFDD 1-1, Aug 98)
M 1.1.5	Percent of the interests of the United States defended from air attack.			AFT1.1, M4 (AFDD 1-1, Aug 98)
M 1.1.6	Percent of enemy air forces defeated			AFT1.1, M5 (AFDD 1-1, Aug 98)
M 1.1.7	Percent of enemy aircraft, missile, and air defense artillery threats countered			AFT1.1, M6 (AFDD 1-1, Aug 98)
M 1.1.8	Time to gain general air supremacy			AFT1.1, M7 (AFDD 1-1, Aug 98)
M 1.1.9	Time general air supremacy maintained			AFT1.1, M8 (AFDD 1-1, Aug 98)
M 1.1.10	% vital air areas controlled			AFT1.1, M9 (AFDD 1-1, Aug 98)
M 1.1.11	Time to establish local air superiority			AFT1.1, M10 (AFDD 1-1, Aug 98)
M 1.1.12	Time to attain a predetermined degree of air superiority			AFT1.1.1, M1 (AFDD 1-1, Aug 98)
M 1.1.13	Time to attain a predetermined degree of air superiority is maintained			AFT1.1.1, M2 (AFDD 1-1, Aug 98)
M 1.1.14	Percent of enemy forces destroyed or neutralized			AFT1.1.1, M3 (AFDD 1-1, Aug 98)
M 1.1.15	Time enemy forces remain destroyed or neutralized			AFT1.1.1, M4 (AFDD 1-1, Aug 98)
M 1.1.16	Cost to perform counterair function			AFT1.1.1, M5 (AFDD 1-1, Aug 98)
M 1.1.17	# of targets found/total targets			Batman and Robin wargame simulation measure

Number	MOP/MOE	Definition (if needed)	Criteria (if needed)	Reference
M 1.1.18	# of targets killed/total targets			Batman and Robin wargame simulation measure
M 1.1.19	# of red kills per blue platform			Batman and Robin wargame simulation measure
M 1.1.20	# of blue kills per red platform			Batman and Robin wargame simulation measure
M 1.1.21	Average range detected	Average range at which Red threats detected by Blue forces		Batman and Robin wargame simulation measure
M 1.1.22	Average range destroyed	Average range at which Red threats destroyed by Blue forces		Batman and Robin wargame simulation measure
M 1.1.23	% missiles detected	% of anti-ship missiles detected by Blue forces		Batman and Robin wargame simulation measure
M 1.1.24	% missiles destroyed	% of anti-ship missiles destroyed by Blue forces		Batman and Robin wargame simulation measure
M 1.1.25	% kills	% of kills by Blue forces (wins) and/or by Red forces (losses)		Batman and Robin wargame simulation measure
M 1.1.26	Engagement times	Comparison between assigned and actual engagement time		William Tell (ACC air-to-air competition)
M 1.1.27	Kills per sortie			William Tell (ACC air-to-air competition)
M 1.1.28	Radar lock Missile times			William Tell (ACC air-to-air competition)
M 1.1.29	Missile miss distance			William Tell (ACC air-to-air competition)
M 1.1.30	# of fratricide incidents	Inadvertent targeting of friendly aircraft		William Tell (ACC air-to-air competition)
<b>1.1.1</b>	<b>Offensive Counter Air (OCA) Operations Measures (AFT 1.1.1.1)</b>			
M 1.1.1.1	% of enemy air and missile power destroyed, neutralized, disrupted, or limited.			AFT 1.1.1.1, M1 (AFDD 1-1, Aug 98)
M 1.1.1.2	Time enemy air and missile power remains destroyed, neutralized, disrupted, or limited.			AFT 1.1.1.1, M2 (AFDD 1-1, Aug 98)
M 1.1.1.3	Percent of enemy air defense targets suppressed			AFT 1.1.1.1, M3 (AFDD 1-1, Aug 98)
M 1.1.1.4	Time enemy air defense targets remained suppressed			AFT 1.1.1.1, M4 (AFDD 1-1, Aug 98)
M 1.1.1.5	Percent of friendly forces protected from enemy air and missile attacks			AFT 1.1.1.1, M5 (AFDD 1-1, Aug 98)
M 1.1.1.6	Cost to conduct counterair function			AFT 1.1.1.1, M6 (AFDD 1-1, Aug 98)
M 1.1.1.7	% of counterair targets destroyed.			HQ USAF/XOOT, 1997
M 1.1.1.8	Minutes to notify friendly counterair forces (to gain intercept position).			HQ USAF/XOOT, 1997
M 1.1.1.9	% of enemy air attacks detected early enough to allow engagement.			HQ USAF/XOOT, 1997
M 1.1.1.10	% of enemy air defense targets successfully engaged.			HQ USAF/XOOT, 1997
M 1.1.1.11	% of enemy aircraft penetrating air defenses.			HQ USAF/XOOT, 1997

Number	MOP/MOE	Definition (if needed)	Criteria (if needed)	Reference
M 1.1.1.12	% of first-shot kills by friendly fighters in air-to-air combat.			HQ USAF/XOOT, 1997
<b>1.1.2</b>	<b><i>Defensive Counter Air (DCA) Operations Measures (AFT 1.1.1.2)</i></b>			
M 1.1.2.1	Percent of attacking enemy air and missiles threats detected and identified			AFT 1.1.1.2, M1 (AFDD 1-1, Aug 98)
M 1.1.2.2	Percent of attacking enemy air and missiles threats intercepted and destroyed or neutralized			AFT 1.1.1.2, M2 (AFDD 1-1, Aug 98)
M 1.1.2.3	Percent of friendly airspace defended from enemy air and missile attacks.			AFT 1.1.1.2, M3 (AFDD 1-1, Aug 98)
M 1.1.2.4	Time friendly airspace remains defended from enemy air & missile attacks			AFT 1.1.1.2, M4 (AFDD 1-1, Aug 98)
M 1.1.2.5	Percent of friendly forces, materiel, and infrastructure are protected from enemy air and missile attack			AFT 1.1.1.2, M5 (AFDD 1-1, Aug 98)
M 1.1.2.6	Time friendly forces, materiel and infrastructure remain protected from enemy air & missile attack.			AFT 1.1.1.2, M6 (AFDD 1-1, Aug 98)
M 1.1.2.7	Cost to conduct DCA			AFT 1.1.1.2, M7 (AFDD 1-1, Aug 98)
<b>1.2</b>	<b><i>Offensive and Defensive Counter Space Operations (AFT 1.2)</i></b>			
M 1.2.1	Time to attain a predetermined degree of space superiority			AFT 1.2.1, M1 (AFDD 1-1, Aug 98)
M 1.2.2	Time a predetermined degree of space superiority is maintained			AFT 1.2.1, M2 (AFDD 1-1, Aug 98)
M 1.2.3	Percent of enemy forces destroyed or neutralized			AFT 1.2.1, M3 (AFDD 1-1, Aug 98)
M 1.2.4	Time enemy forces remain destroyed or neutralized			AFT 1.2.1, M4 (AFDD 1-1, Aug 98)
M 1.2.5	Cost to perform counterspace functions			AFT 1.2.1, M5 (AFDD 1-1, Aug 98)
<b>1.2.1</b>	<b><i>Offensive Counter Space Operations (AFT 1.2.1.1)</i></b>			
M 1.2.1.1	Percent of enemy space assets or capabilities destroyed, neutralized, disrupted, or limited			AFT 1.2.1.1, M1 (AFDD 1-1, Aug 98)
M 1.2.1.2	Time enemy space assets or capabilities remains destroyed, neutralized, disrupted, or limited			AFT 1.2.1.1, M2 (AFDD 1-1, Aug 98)
M 1.2.1.3	Percent of friendly forces protected from attacks from enemy space assets or capabilities			AFT 1.2.1.1, M3 (AFDD 1-1, Aug 98)
M 1.2.1.4	Cost to conduct OCS			AFT 1.2.1.1, M4 (AFDD 1-1, Aug 98)
M 1.2.1.5	% of enemy strategic space assets destroyed/degraded.			HQ USAF/XOOT, 1997
M 1.2.1.6	% of potentially hostile space platforms that can be countered.			HQ USAF/XOOT, 1997

Number	MOP/MOE	Definition (if needed)	Criteria (if needed)	Reference
<b>1.2.2</b>	<b><i>Defensive Counter Space Operations (AFT 1.2.1.2)</i></b>			
M 1.2.2.1	Percent of attacking enemy space and missiles threats detected, tracked and identified			AFT 1.2.1.2, M1 (AFDD 1-1, Aug 98)
M 1.2.2.2	Percent of attacking enemy space and missiles threats intercepted and destroyed or neutralized.			AFT 1.2.1.2, M2 (AFDD 1-1, Aug 98)
M 1.2.2.3	Percent of friendly space forces defended from enemy space and missile attacks.			AFT 1.2.1.2, M3 (AFDD 1-1, Aug 98)
M 1.2.2.4	Time friendly space forces remains defended from enemy space and missile attacks.			AFT 1.2.1.2, M4 (AFDD 1-1, Aug 98)
M 1.2.2.5	Percent of friendly forces, materiel, and infrastructure are protected from enemy space and missile attack			AFT 1.2.1.2, M5 (AFDD 1-1, Aug 98)
M 1.2.2.6	Time friendly forces, materiel and infrastructure remain protected from enemy space and missile attack			AFT 1.2.1.2, M6 (AFDD 1-1, Aug 98)
M 1.2.2.7	Cost to conduct DCS			AFT 1.2.1.2, M7 (AFDD 1-1, Aug 98)
<b>1.3</b>	<b><i>Theater missile defense (TMD )</i></b>			
M 1.3.1	Casualties to civilians attributed to missile attack.			HQ USAF/XOOT, 1997
M 1.3.2	Casualties to military personnel attributed to missile attack.			HQ USAF/XOOT, 1997
M 1.3.3	Minutes warning provided to friendly assets prior to threat arrival.			HQ USAF/XOOT, 1997
M 1.3.4	% of attacking missiles successfully penetrating friendly defenses.			HQ USAF/XOOT, 1997
M 1.3.5	% of launched air-to-surface missiles destroyed before impact.			HQ USAF/XOOT, 1997
M 1.3.6	% of launched ballistic missiles destroyed before impact.			HQ USAF/XOOT, 1997
M 1.3.7	% of launched cruise missiles destroyed before impact.			HQ USAF/XOOT, 1997
M 1.3.8	% of theater assets defensible against theater missile threat.			HQ USAF/XOOT, 1997
M 1.3.9	% of TMD capability damaged by incoming missile attacks.			HQ USAF/XOOT, 1997
<b>1.4</b>	<b><i>General Air Combat Measures</i></b>			
M 1.4.1	# of sorties necessary to perform mission			Rau & Egbert, 1972
M 1.4.2	Days from decision to employ national strategic firepower until desired damage levels achieved.			HQ USAF/XOOT, 1997
M 1.4.3	Time from event detection to data receipt by NORAD.			HQ USAF/XOOT, 1997

Number	MOP/MOE	Definition (if needed)	Criteria (if needed)	Reference
M 1.4.4	% of potential multi-crisis situations (requiring apportionment of national assets), wargamed.			HQ USAF/XOOT, 1997
M 1.4.5	% of space and missile launch events detected.			HQ USAF/XOOT, 1997
M 1.4.6	Days to designate a primary theater in a multicrisis situation (requiring apportionment of forces or assets).			HQ USAF/XOOT, 1997
M 1.4.7	Errors in performance of air surveillance, identification and track monitor procedures.			HQ USAF/XOOT, 1997
M 1.4.8	Minutes to scramble fighters.			HQ USAF/XOOT, 1997
M 1.4.9	% disruption of friendly centers of gravity.			HQ USAF/XOOT, 1997
M 1.4.10	% of attacking aircraft penetrating air defense network.			HQ USAF/XOOT, 1997
M 1.4.11	% of fighters directed against declared hostile aircraft.			HQ USAF/XOOT, 1997
M 1.4.12	% of hostile aircraft and missiles engaged and destroyed.			HQ USAF/XOOT, 1997
M 1.4.13	% of incoming SSMs penetrating defenses.			HQ USAF/XOOT, 1997
M 1.4.14	% of enemy NBC delivery systems identified, targeted, and engaged/destroyed by friendly forces.			HQ USAF/XOOT, 1997
M 1.4.15	Ability to operate in low light, low visibility environments	Combat aircraft must be able to conduct flight operations 24 hours a day (use of Night Vision Devices).		ACC/DRS, 1995a, p. 36; 1995b, p. 17
M 1.4.16	Ability to plan & operate in a laser environment	Ability to determine &/or plot damage zones caused by the use of laser optical systems.		ACC/DRS, 1995a, p. 38
M 1.4.17	Incidents attributed to navigational errors (near miss, contact with enemy, etc.) <i>*Cross reference to Air Mobility Measures</i>			UNTL, 1996, p. 185
M 1.4.18	Incidents of navigational errors due to equipment malfunctions <i>*Cross reference to Air Mobility Measures.</i>			UNTL, 1996, p. 185
M 1.4.19	Incidents of navigational errors due to inadequate maps/charts <i>*Cross reference to Air Mobility Measures.</i>			UNTL, 1996, p. 185
M 1.4.20	Incidents of navigational errors due to training <i>*Cross reference to Air Mobility Measures.</i>			UNTL, 1996, p. 185
M 1.4.21	Mishaps attributed to navigational errors (accidents) <i>*Cross reference to Air Mobility Measures.</i>			UNTL, 1996, p. 185

Number	MOP/MOE	Definition (if needed)	Criteria (if needed)	Reference
M 1.4.22	<b>Threat detection</b> *Cross reference to <i>Flight Detectability/Survivability/Vulnerability measures.</i>	Degree to which aircraft system can detect hostile air and ground threats.		ACC/DRS, 1995a, p. 33
M 1.4.23	<b>% increase in distance traveled due to obstacles</b> *Cross reference to <i>Air Mobility Measures.</i>			UNTL, 1996, p. 187
M 1.4.24	<b>% reduction in average speed of movement due to obstacles</b> *Cross reference to <i>Air Mobility Measures.</i>			UNTL, 1996, p. 187
M 1.4.25	<b>% of casualties suffered while overcoming or bypassing obstacles</b> *Cross reference to <i>Air Mobility Measures.</i>			UNTL, 1996, p. 187
M 1.4.26	<b>Protection and decontamination capabilities</b>	Capability to successfully operate in a nuclear, biological, or chemical (NBC) environment.		ACC/DRS, 1995a, p. 36
M 1.4.27	<b>Aircrew manning ratios</b> *Cross reference to <i>Air Mobility &amp; Performance Capabilities measures.</i>	Sortie generation capability is affected by low manning ratios and low Optempo. Air Reserve Component (ARC), US Air Forces in Europe (USAFE), & Pacific Air Forces (PACAF) aircrew manning ratios are lower than those of ACC units, which does not allow them to sustain operations at the same Optempo. Therefore, warfighting CINCs will not receive the same sortie generation capability from non-ACC units.		ACC/DRS, 1995a, p. 36
M 1.4.28	<b>Enroute/Theater support for mission flexibility</b>	Without sufficient enroute maintenance/C2/aerial port support, combat forces cannot adequately maintain peacetime Optempo in support of humanitarian/peacekeeping operations.		ACC/DRS, 1995a, p. 37
M 1.4.29	<b>Nuclear, Biological, &amp; Chemical (NBC) threat detection</b> *Cross reference to <i>Flight Detectability/Survivability/Vulnerability measures.</i>	Ability to detect the presence of NBC contaminants.		ACC/DRS, 1995a, p. 37
M 1.4.30	<b>Beyond Line of Site (BLOS) communications capabilities</b> *Cross reference to <i>Flight Detectability/Survivability/Vulnerability measures.</i>	BLOS communications are needed for long range control of air defense forces in the detection of an attack.		ACC/DRC, 1995a, p. 12; 1995b, p. 17
M 1.4.31	<b>% of fire requests beyond range</b>	The ratio of all fire missions requested that are not fired because the target is beyond range.		Bornman, 1993, p. 3-5
M 1.4.32	<b># of hours to issue Information Warfare (IW) policy, after crisis onset</b>			UJTL, 1996, p. 4-92
M 1.4.33	<b>% of integrated IW operations completed as planned</b>			UJTL, 1996, p. 4-37

Number	MOP/MOE	Definition (if needed)	Criteria (if needed)	Reference
M 1.4.34	% of integrated IW operations delayed/deferred by lack of complete participating force availability			UJTL, 1996, p. 4-92
M 1.4.35	Days to create frequency deconfliction plan.			HQ USAF/XOOT, 1997
M 1.4.36	Hours delay in enemy action at theater or strategic level because of EA attack.			HQ USAF/XOOT, 1997
M 1.4.37	% of overall effort, devoted to EA.			HQ USAF/XOOT, 1997
M 1.4.38	% of tasked electronic attacks, actually conducted.			HQ USAF/XOOT, 1997
M 1.4.39	# of days to achieve information superiority, after crisis onset			UJTL, 1996, p. 4-92
M 1.4.40	% of friendly operations disrupted by enemy's ability to interfere with friendly information systems			UJTL, 1996, p. 4-37, 4-92
M 1.4.41	Ability to maintain accurate & timely forward edge of the battle area (FEBA) & enemy information	Ability to do manual tracking of the FEBA, enemy movements, enemy air defense artillery, etc.		ACC/DRC, 1995b, p. 16
M 1.4.42	Ability to produce timely & accurate courses of action	Ability to quickly develop & analyze Courses of Action.		ACC/DRC, 1995b, p. 16, 18
M 1.4.43	Ability to positively identify friendlies & hostiles <i>*Cross reference to Flight Detectability/Survivability/Vulnerability measures.</i>			ACC/DRC, 1995b, p. 19
M 1.4.44	Ability to mark targets covertly or in adverse weather <i>*Cross reference to Targeting measures</i>	Covert target marking capability & ability to operate at night.		ACC/DRC, 1995b, p. 20
M 1.4.45	Bomb Damage Assessment <i>*Cross reference to Targeting measures</i>	Ability to determine the extent of bomb damage to target.		Evans, 1996
M 1.4.46	Ability to land on snow <i>*Cross reference to Air Mobility measures</i>	Pilot's ability to land on snow during search & rescue missions.		ACC/DRS, 1995b, p. 20; ASC/XRR, 1996
<b>1.5</b>	<b><i>Air Combat Tactics</i></b>			
M 1.5.1	Formation takeoff		Smooth on controls. Excellent wing-man consideration	AFI 11-2F-16, Volume 1, 1998
M 1.5.2	Trail departure		Trail departure accomplished using proper procedures and techniques. Provided efficient commentary throughout departure and/or rendezvous.	AFI 11-2F-15, Volume 2 DRAFT

Number	MOP/MOE	Definition (if needed)	Criteria (if needed)	Reference
M1.5.3	<b>Tactical formation - Flight lead</b>		Established and maintained appropriate formations utilizing published and briefed procedures. Maintained positive control of flight/element. Smooth on the controls and considered wingman. Planned ahead and made timely decisions. Ensured that wingman flew proper position. Effectively applied Cockpit Resource Management (CRM) skills throughout mission.	AFI 11-2F-15, Volume 2, 1998 DRAFT
M 1.5.4	<b>Tactical Formation – Wingman</b>		Maintained position IAW published and briefed procedures with only momentary deviations. Demonstrated smooth and immediate position corrections. Maintained safe separation and complied with leader's instructions. Rejoin was smooth and timely. Effectively applied CRM skills throughout mission.	AFI 11-2F-15, Volume 2, 1998 DRAFT
M 1.5.5	<b>Tactical navigation</b>		Navigated to desired destination and remained geographically oriented during the tactical portion of the mission along the desired route. Altitude and route of flight reflected consideration for enemy threats. Maintained terrain awareness. Complied with established altitude minimums. Adhered to airspace restrictions.	AFI 11-2F-15, Volume 2 DRAFT
M 1.5.6	<b>Tactical execution</b>		Applied tactics consistent with the threat, current directives, and good judgment. Executed the plan and achieved mission goals. Quickly adapted to changing environment. Maintained situational awareness.	AFI 11-2F-15, Volume 2 DRAFT
M 1.5.7	<b>Tactical intercepts</b>			AFI 11-2F-16, Volume 1, 1998
M 1.5.8	<b>Within visual range engagement</b>			AFI 11-2F-16, Volume 1, 1998
M 1.5.9	<b>Beyond visual range engagement</b>			AFI 11-2F-16, Volume 1, 1998
M 1.5.10	<b>Sweep procedures</b>			AFI 11-2F-16, Volume 1, 1998

<b>Number</b>	<b>MOP/MOE</b>	<b>Definition (if needed)</b>	<b>Criteria (if needed)</b>	<b>Reference</b>
M 1.5.11	<b>Lane/point defense procedures</b>			AFI 11-2F-16, Volume 1, 1998
M 1.5.12	<b>Disengagement/ combat separation procedures</b>		Adhered to briefed/directed separation procedures. Positive control of flight/element during separation. Maintained mutual support with adversary unable to achieve valid simulated missile/gun-firing parameters.	AFI 11-2F-15, Volume 2, 1998 DRAFT
M 1.5.13	<b>Formation landing</b>			AFI 11-2F-16, Volume 1, 1998
M 1.5.14	<b>Ground Control Intercept (GCI)/Airborne Warning and Control System (AWACS)/ composite force interface</b>		Effectively planned for and used GCI/ AWACS to enhance mission and achieve objectives. No confusion between GCI/ AWACS and fighters.	AFI 11-2F-15, Volume 2 DRAFT
M 1.5.15	<b>Visual lookout</b>		Demonstrated thorough knowledge and effective application of visual lookout techniques for all phases of flight	AFI 11-2F-15, Volume 2 DRAFT
M 1.5.16	<b>Mutual support</b>		Maintained mutual support during entire engagement thus sustaining an offensive posture and/or negating all attacks. Adhered to all engaged and support responsibilities	AFI 11-2F-15, Volume 2 DRAFT
M 1.5.17	<b>Ingress</b>		Aware of all known/simulated threats and defenses. Employed effective use of terrain masking and/or route and altitude selection	AFI 11-2F-15, Volume 2 DRAFT
M 1.5.18	<b>Egress</b>		Effectively used evasive maneuvers and terrain masking to complete an expeditious egress from the target area. Flight/element join-up was accomplished as soon as possible without undue exposure to enemy defenses.	AFI 11-2F-15, Volume 2 DRAFT
M 1.5.19	<b>Timing</b>	Time will be based on pre-planned vulnerability period (Defensive Counter Air (DCA)) or push time (Offensive Counter Air (OCA) Sweep).	± 1 minute. Covered TOT	AFI 11-2F-15, Volume 2 DRAFT
M 1.5.20	<b>Threat reactions</b>		Threat reactions were timely and correct. Accomplished appropriate countermeasures and performed maneuvers to counter threat.	AFI 11-2F-15, Volume 2 DRAFT

<b>Number</b>	<b>MOP/MOE</b>	<b>Definition (if needed)</b>	<b>Criteria (if needed)</b>	<b>Reference</b>
M 1.5.21	<b>Electronic attack (EA)/Electronic protect (EP)/All Aspect Missile Defense (AAMD)</b>		Correct interpretation of threat scope aural tones, warning lights and operation of CMD/ICS systems	AFI 11-2F-15, Volume 2 DRAFT
M 1.5.22	<b>Radar scope/sensor utilization</b>		Correctly utilized all on board sensors to successfully employ weapons systems	AFI 11-2F-15, Volume 2 DRAFT
M 1.5.23	<b>Radar search/sorting technique</b>		Demonstrated satisfactory knowledge and effective application of radar search/sorting techniques for all phases of flight. Recognized chaff/EA and compensated for lock transfer. Utilized radar, with proper EP techniques, to maximum extent possible	AFI 11-2F-15, Volume 2 DRAFT AFI 11-2F-15E, Volume 2 DRAFT
M 1.5.24	<b>Air sovereignty tasking</b>		Responded properly to directive commentary. Completed all required armament/ safety checks. Successfully completed visual identification pass. Properly performed procedures for air defense operations.	AFI 11-2F-16, Volume 2, 1998
M 1.5.25	<b>Tactical intercept/patrol</b>		Thorough knowledge and correct employment of tactical intercept procedures. Intercept resulted in a successful VID/EID followed by an offensive attack, if applicable. CAP successfully employed and designated airspace patrolled in a satisfactory manner	AFI 11-2F-16, Volume 2, 1998 AFI 11-2F-15E, Volume 2 DRAFT
M 1.5.26	<b>Offensive maneuvering</b>		Effective use of basic fighter maneuvering and air combat maneuvering to attack/counter opposing aircraft. Good aircraft control. Effectively managed energy level during engagements.	AFI 11-2F-16, Volume 2, 1998 AFI 11-2F-15E, Volume 2 DRAFT
M 1.5.27	<b>Defensive/ counteroffensive maneuvering- PILOT</b>		Performed correct initial move to counter attack of opposing aircraft. Used correct maneuvers to negate the threat	AFI 11-2F-16, Volume 2, 1998 AFI 11-2F-15E, Volume 2 DRAFT

Number	MOP/MOE	Definition (if needed)	Criteria (if needed)	Reference
M 1.5.28	Defensive/ counteroffensive maneuvering- WSO		Demonstrated a satisfactory knowledge and understanding of initial moves. Directed the initial move correctly to counter attack of opposing aircraft. Directed timely counters for the pilot when necessary	AFI 11-2F-15E, Volume 2 DRAFT
M 1.5.29	Air-to-air weapons employment		Demonstrated proper knowledge of missile/gun firing procedures and attack parameters. Simulated missile/gun-firing were accomplished at each opportunity and within designated parameters. Successfully completed 75 percent (or two of three/one of two) of attempted shots	AFI 11-2F-16, Volume 2, 1998
<b>1.6</b>	<b>Low Altitude Air-to-Air Employment</b>			
M 1.6.1	Level intercepts			AFI 11-2F-16, Volume 1, 1998
M 1.6.2	Low altitude weapons employment			AFI 11-2F-16, Volume 1, 1998
M 1.6.3	Weapons envelope			AFI 11-2F-16, Volume 1, 1998
M 1.6.4	Weapons selection			AFI 11-2F-16, Volume 1, 1998
M 1.6.5	Minimum launch altitudes			AFI 11-2F-16, Volume 1, 1998
M 1.6.6	Low altitude intercept			AFI 11-2F-16, Volume 1, 1998
<b>1.7</b>	<b>Suppression of Enemy Air Defenses (SEAD) (No comparable AFT, ACC MAP 1)</b>			
M 1.7.1	Operational objective	Neutralize air defense systems		ACC MAP 1
M 1.7.2	Primary task	Defeat mobile surface-to –air (SAM) threats		ACC MAP 1
M 1.7.3	Primary task	Defeat fixed surface-to –air threats		ACC MAP 1
<b>1.7.1</b>	<b>Lethal Suppression of Enemy Air Defenses (SEAD) (No comparable AFT, ACC MAP 1)</b>			
M 1.7.1.1	Lethal suppression concept	Lethal SEAD and attack assets marshal, penetrate, and egress selected target areas, thereby increasing their survivability.		ACC MAP 1
M 1.7.1.2	Reactive suppression	Immediate response to observed SAM threat	Detect and identify (ID) and locate surface-to-air threats, employ weapons in a time critical environment to protect friendly forces from hostile engagement	ACC MAP 1
M 1.7.1.3	Preemptive destruction of Integrated Air Defense System	Locate and destroy mobile and fixed targets in advance of a strike package at a pre-determined time		ACC MAP 1

Number	MOP/MOE	Definition (if needed)	Criteria (if needed)	Reference
M 1.7.1.4	<b>Electronic Order of Battle (EOB) management</b>	Prompt detection, analysis, and prioritization of factor threats. Efficient and timely use of available on or offboard systems to effectively detect, target, and suppress threat emitters. Identified correct threats IAW prebriefed game plan. Correctly reacted to pop-up threats in a timely manner		AFI 11-2F-16 Volume 2, 1998
M 1.7.1.5	<b>HARM employment</b>	Correct employment parameters and armament switch settings		AFI 11-2F-16 Volume 2, 1998
<b>1.7.2</b>	<b><i>Non-Lethal Suppression of Enemy Air Defenses (SEAD) (No comparable AFT, ACC MAP 1)</i></b>			
M 1.7.2.1	<b>Non-lethal attack concept</b>	platforms assist attack force assets in accomplishing mission by employing ECM against radars and communications (voice/datalink) systems		ACC MAP 1
M 1.7.2.2	<b>Radar jamming</b>			ACC MAP 1
M 1.7.2.3	<b>Counter enemy command and control capability</b>			ACC MAP 1
<b>2</b>	<b>PRECISION ENGAGEMENT (AFT 2)</b>			
<b>2.1</b>	<b><i>Lethal Precision Engagement Operations Measures (AFT 2.1)</i></b>			
M 2.1.1	<b>Percent of forces organized for precise lethal attack operations and, as directed, support of other forces</b>			AFT 2.1, M 1 (AFDD 1-1, Aug 98)
M 2.1.2	<b>Percent of forces equipped for precise lethal attack operations and, as directed, support of other forces</b>			AFT 2.1, M 2 (AFDD 1-1, Aug 98)
M 2.1.3	<b>Percent of forces trained for precise lethal attack operations and, as directed, support of other forces.</b>			AFT 2.1, M 3 (AFDD 1-1, Aug 98)
M 2.1.4	<b>Percent of requested forces provided for precise lethal attack</b>			AFT 2.1, M 4 (AFDD 1-1, Aug 98)
M 2.1.5	<b>Percent of effective prosecution of precise lethal attack operations</b>			AFT 2.1, M 5 (AFDD 1-1, Aug 98)
M 2.1.6	<b>Time from the desired timing for lethal force to cause desired effects.</b>			AFT 2.1.1, M 1 (AFDD 1-1, Aug 98)
M 2.1.7	<b>Distance from desired impact point for precision weapons</b>			AFT 2.1.1, M 2 (AFDD 1-1, Aug 98)
M 2.1.8	<b>Distance from desired location for force placement or position</b>			AFT 2.1.1, M 3 (AFDD 1-1, Aug 98)
M 2.1.9	<b>Percent desired strategic effects achieved</b>			AFT 2.1.1, M 4 (AFDD 1-1, Aug 98)
M 2.1.10	<b>Percent desired operational effects achieved</b>			AFT 2.1.1, M 5 (AFDD 1-1, Aug 98)
M 2.1.11	<b>Percent desired tactical effects achieved.</b>			AFT 2.1.1, M 6 (AFDD 1-1, Aug 98)
M 2.1.12	<b>Cost to perform lethal precision engagement</b>			AFT 2.1.1, M 7 (AFDD 1-1, Aug 98)

Number	MOP/MOE	Definition (if needed)	Criteria (if needed)	Reference
<b>2.2</b>	<b><i>Non-Lethal Precision Engagement Operations Measures (AFT 2.2)</i></b>			
M 2.2.1	Percent of forces organized for the effective prosecution of precise nonlethal attack operations.			AFT 2.2, M 1 (AFDD 1-1, Aug 98)
M 2.2.2	Percent of forces equipped for the effective prosecution of precise nonlethal attack operations.			AFT 2.2, M 2 (AFDD 1-1, Aug 98)
M 2.2.3	Percent of forces trained for the effective prosecution of precise nonlethal attack operations.			AFT 2.2, M 3 (AFDD 1-1, Aug 98)
M 2.2.4	Percent of requested forces provided for the effective prosecution of precise nonlethal attack operations.			AFT 2.2, M 4 (AFDD 1-1, Aug 98)
M 2.2.5	Percent of effective prosecution of precise nonlethal attack.			AFT 2.2, M 5 (AFDD 1-1, Aug 98)
M 2.2.6	Time from the desired timing for nonlethal force to cause desired effects			AFT 2.2.1, M 1 (AFDD 1-1, Aug 98)
M 2.2.7	Distance from desired location for force placement or position			AFT 2.2.1, M 2 (AFDD 1-1, Aug 98)
M 2.2.8	Percent desired strategic effects achieved			AFT 2.2.1, M 3 (AFDD 1-1, Aug 98)
M 2.2.9	Percent desired operational effects achieved			AFT 2.2.1, M 4 (AFDD 1-1, Aug 98)
M 2.2.10	Percent desired tactical effects achieved.			AFT 2.2.1, M 5 (AFDD 1-1, Aug 98)
M 2.2.11	Cost to perform nonlethal precision engagement.			AFT 2.2.1, M 6 (AFDD 1-1, Aug 98)
<b>2.3</b>	<b><i>Combat search and rescue (CSAR) (AFT 2.3)</i></b>			
<b>2.3.1</b>	<b><i>Search, Rescue, and Recovery Measures (AFT 2.3 and ACC MAP 4)</i></b>			
M 2.3.1.1	Percent of forces organized for the effective prosecution of CSAR.			AFT 2.3, M 1 (AFDD 1-1, Aug 98)
M 2.3.1.2	Percent of forces equipped for the effective prosecution of CSAR.			AFT 2.3, M 2 (AFDD 1-1, Aug 98)
M 2.3.1.3	Percent of forces trained for the effective prosecution of CSAR.			AFT 2.3, M 3 (AFDD 1-1, Aug 98)
M 2.3.1.4	Percent of requested forces provided for the effective prosecution of CSAR.			AFT 2.3, M 4 (AFDD 1-1, Aug 98)
M 2.3.1.5	Percent of effective prosecution of precise CSAR.			AFT 2.3, M 5 (AFDD 1-1, Aug 98)
M 2.3.1.6	Time to recover distressed isolated personnel during wartime or contingency as necessary			AFT 2.3.1, M 1 (AFDD 1-1, Aug 98)
M 2.3.1.7	Number of personnel recovered during wartime or contingency operations			AFT 2.3.1, M 2 (AFDD 1-1, Aug 98)
M 2.3.1.8	Percent of successful CSAR operations			AFT 2.3.1, M 3 (AFDD 1-1, Aug 98)

Number	MOP/MOE	Definition (if needed)	Criteria (if needed)	Reference
M 2.3.1.9	Cost to perform CSAR functions			AFT 2.3.1, M 4 (AFDD 1-1, Aug 98)
M 2.3.1.10	% of aircrews (that transmit their location) rescued within 24 hours of being forced down (in wartime)			HQ USAF/XOOT, 1997
M 2.3.1.11	% of personnel missing in aircraft accidents, ship sinkings, or field maneuvers recovered (in peacetime)			HQ USAF/XOOT, 1997
M 2.3.1.12	% of aircrews missing behind enemy lines recovered			HQ USAF/XOOT, 1997
M 2.3.1.13	% of non aircrew personnel missing behind enemy lines recovered			HQ USAF/XOOT, 1997
M 2.3.1.14	Minutes required to respond to crash or incident			HQ USAF/XOOT, 1997
<b>2.3.2</b>	<b>Combat search and rescue measures (ACC MAP 4)</b>			
M 2.3.2.1	Survivor location and identification	Found survivor w/o highlighting or endangering the survivor. Used proper authentication without information compromise.		AFI 11-2A/OA-10, Volume 2, 1998
M 2.3.2.2	Survivor protection	Effectively neutralized any threats		AFI 11-2A/OA-10, Volume 2, 1998
M 2.3.2.3	Helicopter rendezvous and escort	Managed efficient and timely rendezvous Employed effective escort procedures		AFI 11-2A/OA-10, Volume 2, 1998
M 2.3.2.4	Pick up briefing and execution	Efficient and timely with asset coordination		AFI 11-2A/OA-10, Volume 2, 1998
M 2.3.2.5	On scene command	Ability to effectively control and employ available assets		AFI 11-2F-16, Volume 1, 1998
M 2.3.2.6	Electronic and visual search			AFI 11-2F-16, Volume 1, 1998
M 2.3.2.7	Threat suppression	Ability to suppress or eliminate threats		AFI 11-2F-16, Volume 1, 1998
M 2.3.2.8	Communications relay			AFI 11-2F-16, Volume 1, 1998
<b>2.3.3</b>	<b>Tactical aeromedical evacuation (AIREVAC) (AFT 2.3.1)</b>			
	[to be added]			
<b>3</b>	<b>INFORMATION SUPERIORITY (AFT 3)</b>			
<b>3.1</b>	<b>Information operation capability (AFT 3.1)</b>			
M 3.1.1	Percent of required forces organized to gain, exploit, defend or attack information & information systems.			AFT 3.1, M 1 (AFDD 1-1, Aug 98)
M 3.1.2	Percent of required forces equipped to gain, exploit, defend or attack information & information systems.			AFT 3.1, M 2 (AFDD 1-1, Aug 98)
M 3.1.3	Percent of required forces trained to gain, exploit, defend or attack information & information systems.			AFT 3.1, M 3 (AFDD 1-1, Aug 98)

Number	MOP/MOE	Definition (if needed)	Criteria (if needed)	Reference
M 3.1.4	Percent of required forces furnished to gain, exploit, defend or attack information & information systems.			AFT 3.1, M 4 (AFDD 1-1, Aug 98)
<b>3.2</b>	<b><i>Surveillance measures (AFT 3.1.1.1.2)</i></b>			
M 3.2.1	Time to systematically observe air, space, surface, or subsurface areas, places, persons, or things, by visual, aural, electronic, photographic, or other means			AFT 3.1.1.1.2, M 1 (AFDD 1-1, Aug 98)
M 3.2.2	Percent of accuracy to which air, space, surface, or subsurface areas, places, persons, or things, can be observed by visual, aural, electronic, photographic, or other means			AFT 3.1.1.1.2, M 2 (AFDD 1-1, Aug 98)
M 3.2.3	Cost to perform surveillance			AFT 3.1.1.1.2, M 3 (AFDD 1-1, Aug 98)
<b>3.2.1</b>	<b><i>Counter-drug operations (No comparable AFT, AFI 11-2F-16)</i></b>			
M 3.2.1.1	Night intercepts on slow/low non-maneuvering targets	Targets below 5000 agl and/or less than 250 kias	Maintain flight safety, S.A. and position of advantage	AFI 11-2F-16, Volume 1, 1998
M 3.2.1.2	VID/shadowing procedures with and without radar locks		Maintain flight safety, S.A. and position of advantage	AFI 11-2F-16, Volume 1, 1998
M 3.2.1.3	Scramble starts and procedures		Airborne within 5 minutes	AFI 11-2F-16, Volume 1, 1998
M 3.2.1.4	Night trail formation procedures			AFI 11-2F-16, Volume 1, 1998
M 3.2.1.5	Basic stern and front quarter mark/blow through intercepts on a slow/low target	Targets below 5000 agl and/or less than 250 kias	Maintain flight safety, S.A. and position of advantage	AFI 11-2F-16, Volume 1, 1998
M 3.2.1.6	Stern conversions on a lights-out target		Maintain flight safety, S.A. and position of advantage	AFI 11-2F-16, Volume 1, 1998
M 3.2.1.7	VID and overrun procedures using Night Vision Devices (NVD)		Maintain flight safety, S.A. and position of advantage	AFI 11-2F-16, Volume 1, 1998
M 3.2.1.8	NVD assembly and system checks			AFI 11-2F-16, Volume 1, 1998
<b>3.3</b>	<b><i>Reconnaissance measures (AFT 3.1.1.1.3) *</i></b>			
M 3.3.1	Time to obtain, by visual observation or other detection methods, specific information about activities and resources of an adversary or potential adversary			AFT *, M 1 (AFDD 1-1, Aug 98)
M 3.3.2	Time to secure data concerning the meteorological, hydrographic, or geographic characteristics of a particular area			AFT *, M 2 (AFDD 1-1, Aug 98)
M 3.3.3	& of accuracy to which specific information about the activities and resources of an adversary or potential adversary is obtained			AFT *, M 3 (AFDD 1-1, Aug 98)

Number	MOP/MOE	Definition (if needed)	Criteria (if needed)	Reference
M 3.3.4	Cost to perform reconnaissance			AFT *, M 4 (AFDD 1-1, Aug 98)
M 3.3.5	Hours for reconnaissance or surveillance assets to respond (from receipt of tasking)			HQ USAF/XOOT, 1997
M 3.3.6	Hours until reconnaissance or surveillance assets respond (from receipt of tasking).			HQ USAF/XOOT, 1997
M 3.3.7	Instances of failure to respond to commander's requirements for reconnaissance or surveillance assets.			HQ USAF/XOOT, 1997
M 3.3.8	% of commander's geographic area having required reconnaissance and surveillance assets.			HQ USAF/XOOT, 1997
M 3.3.9	Hours to redirect surveillance or reconnaissance assets to meet overriding joint force commander or national level collection requirements.			HQ USAF/XOOT, 1997
M 3.3.10	% of theater strategic activities requiring access to space (e.g. reconnaissance, surveillance, communications), not conducted.			HQ USAF/XOOT, 1997
M 3.3.11	Target Acquisition	Successfully acquired all assigned/attempted targets IAW mission requirements		AFI 11-2F-16 Volume 2 1998
M 3.3.12	Photo Quality	Target optimally positioned within photograph, permitting accurate confirmation of EEI		AFI 11-2F-16 Volume 2 1998
M 3.3.13	EEI	Accuracy on required EEI met or exceeded 75 percent		AFI 11-2F-16 Volume 2 1998
<b>3.4</b>	<b><i>Weather service measures (AFT 3.1.1.1.4)</i></b>			
M 3.4.1	Time to supply timely and accurate environmental information			AFT 3.1.1.1.4, M 1 (AFDD 1-1, Aug 98)
M 3.4.2	Percent of accuracy in supplied environmental information			AFT 3.1.1.1.4, M 2 (AFDD 1-1, Aug 98)
M 3.4.3	Cost to supply timely and accurate environmental information			AFT 3.1.1.1.4, M 3 (AFDD 1-1, Aug 98)
<b>3.5</b>	<b><i>Navigation and positioning measures (AFT 3.1.1.1.5)</i></b>			
M 3.5.1	Distance from desired location of reference in support of strategic, operational, and tactical operations.			AFT 3.1.1.1.5, M 1 (AFDD 1-1, Aug 98)
M 3.5.2	Time from desired time of reference in support of strategic, operational, and tactical operations.			AFT 3.1.1.1.5, M 2 (AFDD 1-1, Aug 98)
M 3.5.3	Percent of successful locations of reference in support of strategic, operational, and tactical operations.			AFT 3.1.1.1.5, M 3 (AFDD 1-1, Aug 98)

Number	MOP/MOE	Definition (if needed)	Criteria (if needed)	Reference
M 3.5.4	Cost to arrive at the time of reference in support of strategic, operational, and tactical operations.			AFT 3.1.1.1.5, M 4 (AFDD 1-1, Aug 98)
<b>3.6</b>	<b>Counter-information (AFT 3.1.1.2.1)</b>			
<b>3.6.1</b>	<b>Offensive counter-information (OCI) (AFT 3.1.1.2.1.1)</b>			
M 3.6.1.1	Percent of enemy information capabilities destroyed, neutralized, disrupted, or limited.			AFT 3.1.1.2.1.1, M 1 (AFDD 1-1, Aug 98)
M 3.6.1.2	Time to destroy, neutralize, disrupt, or limit enemy information capabilities.			AFT 3.1.1.2.1.1, M 2 (AFDD 1-1, Aug 98)
M 3.6.1.3	Time enemy information capabilities remains destroyed, neutralized, disrupted, or limited.			AFT 3.1.1.2.1.1, M 3 (AFDD 1-1, Aug 98)
M 3.6.1.4	Percent of friendly forces protected from enemy air and missile attacks.			AFT 3.1.1.2.1.1, M 4 (AFDD 1-1, Aug 98)
M 3.6.1.5	Cost to conduct counterair function.			AFT 3.1.1.2.1.1, M 5 (AFDD 1-1, Aug 98)
<b>3.6.2</b>	<b>Psychological operations (PSYOP) (AFT 3.1.1.2.1.1.1)</b>			
M 3.6.2.1	Percent desired strategic effects achieved.			AFT 3.1.1.2.1.1.1, M 1 (AFDD 1-1, Aug 98)
M 3.6.2.2	Percent desired operational effects achieved.			AFT 3.1.1.2.1.1.1, M 2 (AFDD 1-1, Aug 98)
M 3.6.2.3	Percent desired tactical effects achieved.			AFT 3.1.1.2.1.1.1, M 3 (AFDD 1-1, Aug 98)
M 3.6.2.4	Cost to conduct PSYOP.			AFT 3.1.1.2.1.1.1, M 4 (AFDD 1-1, Aug 98)
<b>3.6.3</b>	<b>Electronic warfare measures (EW) (AFT 3.1.1.2.1.1.2)</b>			
M 3.6.3.1	Time for electronic warfare capabilities to achieve desired effects.			AFT 3.1.1.2.1.1.2, M 1 (AFDD 1-1, Aug 98)
M 3.6.3.2	Percent desired strategic effects achieved.			AFT 3.1.1.2.1.1.2, M 2 (AFDD 1-1, Aug 98)
M 3.6.3.3	Percent desired operational effects achieved.			AFT 3.1.1.2.1.1.2, M 3 (AFDD 1-1, Aug 98)
M 3.6.3.4	Percent desired tactical effects achieved.			AFT 3.1.1.2.1.1.2, M 4 (AFDD 1-1, Aug 98)
M 3.6.3.5	Cost to conduct electronic warfare.			AFT 3.1.1.2.1.1.2, M 5 (AFDD 1-1, Aug 98)
M 3.6.3.6	% reduction in enemy signals volume (after implementation of EW plan).			HQ USAF/XOOT, 1997
M 3.6.3.7	% reduction in enemy signals volume (at implementation of EW plan).			HQ USAF/XOOT, 1997
M 3.6.3.8	Hours to initiate electronic attack (after ordered).			HQ USAF/XOOT, 1997

Number	MOP/MOE	Definition (if needed)	Criteria (if needed)	Reference
M 3.6.3.9	% of electronic attacks achieving desired effects on enemy.			HQ USAF/XOOT, 1997
M 3.6.3.10	% of tasked electronic attacks conducted.			HQ USAF/XOOT, 1997
M 3.6.3.11	% reduction in enemy communications emissions (after EW attack).			HQ USAF/XOOT, 1997
M 3.6.3.12	% reduction in enemy signals volume (after implementation of EW plan).			HQ USAF/XOOT, 1997
M 3.6.3.13	% reduction in enemy signals volume (at implementation of EW plan).			HQ USAF/XOOT, 1997
M 3.6.3.14	% of enemy air defense capabilities neutralized by non-lethal means.			HQ USAF/XOOT, 1997
<b>3.6.4</b>	<b><i>Defensive counter-information (DCI) (AFT 3.1.1.2.1.2)</i></b>			
M 3.6.4.1	Number of adversary information operations/ information warfare threats detected and identified.			AFT 3.1.1.2.1.2, M 1 (AFDD 1-1, Aug 98)
M 3.6.4.2	Percent of detected adversary information operations/information warfare threats neutralized.			AFT 3.1.1.2.1.2, M 2 (AFDD 1-1, Aug 98)
M 3.6.4.3	Percent of friendly information, information systems, and information operations protected from adversary.			AFT 3.1.1.2.1.2, M 3 (AFDD 1-1, Aug 98)
M 3.6.4.4	Cost to perform defensive counterinformation functions.			AFT 3.1.1.2.1.2, M 4 (AFDD 1-1, Aug 98)
<b>3.6.5</b>	<b><i>Electronic protection (EP) (AFT 3.1.1.2.1.2.5)</i></b>			
M 3.6.5.1	Number of adversary electronic warfare threats detected and identified.			AFT 3.1.1.2.1.2.5, M 1 (AFDD 1-1, Aug 98)
M 3.6.5.2	Percent of detected adversary electronic warfare threats neutralized.			AFT 3.1.1.2.1.2.5, M 2 (AFDD 1-1, Aug 98)
M 3.6.5.3	% of friendly personnel, facilities, and equipment protected from the adversary electronic warfare.			AFT 3.1.1.2.1.2.5, M 3 (AFDD 1-1, Aug 98)
M 3.6.5.4	Cost to conduct electronic protection.			AFT 3.1.1.2.1.2.5, M 4 (AFDD 1-1, Aug 98)
<b>3.6.6</b>	<b><i>Counterdeception (AFT 3.1.1.2.1.2.6)</i></b>			
M 3.6.6.1	Number of adversary deception operations detected and identified.			AFT 3.1.1.2.1.2.6, M 1 (AFDD 1-1, Aug 98)

Number	MOP/MOE	Definition (if needed)	Criteria (if needed)	Reference
M 3.6.6.2	Percent of detected adversary deception operations neutralized.			AFT 3.1.1.2.1.2.6, M 2 (AFDD 1-1, Aug 98)
M 3.6.6.3	Time to detect adversary deception operations.			AFT 3.1.1.2.1.2.6, M 3 (AFDD 1-1, Aug 98)
M 3.6.6.4	Cost to conduct counter-deception operations.			AFT 3.1.1.2.1.2.6, M 4 (AFDD 1-1, Aug 98)
<b>4</b>	<b>GLOBAL ATTACK (AFT 4 – ACC MAP 2)</b>			
M 4.1	Percent of desired strategic effects achieved			AFT 4, M1 (AFDD 1-1, Aug 98)
M 4.2	Percent of desired operational effects achieved			AFT 4, M2 (AFDD 1-1, Aug 98)
M 4.3	Percent of desired tactical effects achieved			AFT 4, M3 (AFDD 1-1, Aug 98)
M 4.4	Percent of successful precision engagements			AFT 4, M4 (AFDD 1-1, Aug 98)
M 4.5	Number of successful precision engagements			AFT 4, M5 (AFDD 1-1, Aug 98)
<b>4.1</b>	<b>Strategic Attack (AFT 4.1 – ACC MAP 2)</b>			
<b>4.1.1</b>	<b>Strategic Attack Capabilities (AFT 4.1)</b>			
M 4.1.1.1	Percent of forces organized for strategic attack operations and, as directed, in support of other forces.			AFT 4.1, M 1 (AFDD 1-1, Aug 98)
M 4.1.1.2	Percent of forces equipped for strategic attack operations and, as directed, in support of other forces.			AFT 4.1, M 2 (AFDD 1-1, Aug 98)
M 4.1.1.3	Percent of forces trained for strategic attack operations and, as directed, in support of other forces.			AFT 4.1, M 3 (AFDD 1-1, Aug 98)
2.1.1.4	Percent of requested forces provided for strategic attack.			AFT 4.1, M 4 (AFDD 1-1, Aug 98)
2.1.1.5	Percent of effective prosecution of strategic attack operations.			AFT 4.1, M 5 (AFDD 1-1, Aug 98)
<b>4.1.2</b>	<b>Perform Strategic Attack (AFT 4.1.1)</b>			
M 4.1.2.1	Percent of Earth's surface area accessible to USAF strategic attack.			AFT 4.1.1, M 1 (AFDD 1-1, Aug 98)
M 4.1.2.2	Time from desired timing for strategic attack forces to execute assigned missions.			AFT 4.1.1, M 2 (AFDD 1-1, Aug 98)
M 4.1.2.3	Distance from sortie location to point of weapons release against designated targets.			AFT 4.1.1, M 3 (AFDD 1-1, Aug 98)
M 4.1.2.4	Time from desired timing for strategic attack operations to cause desired effects.			AFT 4.1.1, M 4 (AFDD 1-1, Aug 98)
M 4.1.2.5	Percent desired strategic effects achieved.			AFT 4.1.1, M 5 (AFDD 1-1, Aug 98)
M 4.1.2.6	Cost to perform strategic attack.			AFT 4.1.1, M 6 (AFDD 1-1, Aug 98)

Number	MOP/MOE	Definition (if needed)	Criteria (if needed)	Reference
<b>4.2</b>	<b>Counter-land operations (AFT 4.2)</b>			
M 4.2.1	Percent of desired strategic effects achieved			AFT 4.2.1, M 1 (AFDD 1-1, Aug 98)
M 4.2.2	Percent of desired operational effects achieved.			AFT 4.2.1, M 2 (AFDD 1-1, Aug 98)
M 4.2.3	Percent of desired tactical effects achieved			AFT 4.2.1, M 3 (AFDD 1-1, Aug 98)
M 4.2.4	Percent of enemy surface forces destroyed or neutralized			AFT 4.2.1, M 4 (AFDD 1-1, Aug 98)
M 4.2.5	Cost to perform counter land functions			AFT 4.2.1, M 5 (AFDD 1-1, Aug 98)
<b>4.2.1</b>	<b>Interdict enemy landpower (AFT 4.2.1.1 – ACC MAP 2)</b>			
M 4.2.1.1	Percent of desired strategic effects achieved			AFT 4.2.1.1, M 1 (AFDD 1-1, Aug 98)
M 4.2.1.2	Percent of desired operational effects achieved			AFT 4.2.1.1, M 2 (AFDD 1-1, Aug 98)
M 4.2.1.3	Percent of desired tactical effects achieved			AFT 4.2.1.1, M 3 (AFDD 1-1, Aug 98)
M 4.2.1.4	Percent of enemy C2 systems, personnel, materiel, logistics, and/or supporting systems disrupted, delayed, or destroyed			AFT 4.2.1.1, M 4 (AFDD 1-1, Aug 98)
M 4.2.1.5	Number of sorties required to achieve desired effects			AFT 4.2.1.1, M 5 (AFDD 1-1, Aug 98)
M 4.2.1.6	Time to achieve desired effects			AFT 4.2.1.1, M 6 (AFDD 1-1, Aug 98)
M 4.2.1.7	Cost to conduct interdiction			AFT 4.2.1.1, M 7 (AFDD 1-1, Aug 98)
<b>4.2.1.1</b>	<b>General interdiction analysis measures (No comparable AFT)</b>			
M 4.2.1.1.1		The expected % of the commodity demand which can be filled in spite of interdiction.		Battilega & Grange, 1984, p. 55
M 4.2.1.1.2	<b>Demand response time</b>	The expected time to fulfill the throughput demand in the face of interdiction.		Battilega & Grange, 1984, p. 55
M 4.2.1.1.3	<b>Time to halt enemy advance</b>	The time required to stop an enemy invasion (by land, air, or sea).		JAST, 1995
M 4.2.1.1.4	<b>Expected throughput capacity</b>	The expected (normally single commodity) capacity of the logistics network, considering the uncertainty caused by the requirement to survive interdiction attempts.		Battilega & Grange, 1984, p. 56
M 4.2.1.1.5	<b>Red offensive sorties reduced over time</b>	Reduction in baseline Red sortie rate due to Blue actions.		JAST, 1995
M 4.2.1.1.6	<b>% of critical resources destroyed</b>			JAST, 1995
M 4.2.1.1.7	<b>% of air interdiction targets destroyed.</b>			HQ USAF/XOOT, 1997
M 4.2.1.1.8	<b>Air superiority</b>	The extent to which operations in the air, over sea or, and over land can be conducted with acceptable losses due to hostile air forces and air defense systems action.		CJCSM, 1996

Number	MOP/MOE	Definition (if needed)	Criteria (if needed)	Reference
M 4.2.1.1.9	Time to gain air superiority			JAST, 1995
M 4.2.1.1.10	# of attacks on Blue over time			JAST, 1995
<b>4.2.1.2</b>	<b>Close air support (CAS) (AFT 4.2.1.2 – ACC MAP 2)</b>			
M 4.2.1.2.1	Percent of desired tactical effects achieved.			AFT 4.2.1.2, M 1 (AFDD 1-1, Aug 98)
M 4.2.1.2.2	Time to provide close air support operations at the request of friendly surface forces			AFT 4.2.1.2, M 2 (AFDD 1-1, Aug 98)
M 4.2.1.2.3	Percent of requests for close air support from friendly surface forces executed in a timely manner.			AFT 4.2.1.2, M 3 (AFDD 1-1, Aug 98)
M 4.2.1.2.4	Number of sorties required to achieve desired effects.			AFT 4.2.1.2, M 4 (AFDD 1-1, Aug 98)
M 4.2.1.2.5	Number of “friendly fire” incidents involving close air support sorties			AFT 4.2.1.2, M 5 (AFDD 1-1, Aug 98)
M 4.2.1.2.6	Cost to conduct close air support			AFT 4.2.1.2, M 6 (AFDD 1-1, Aug 98)
<b>4.2.1.2.1</b>	<b>FORWARD AIR CONTROL (NO COMPARABLE AFT – AFI 11-2A/OA-10)</b>			
M 4.2.1.2.1.1	Tactical Air Control System coordination	Effected timely coordination with all appropriate agencies		AFI 11-2A/OA-10, Volume 2, 1998
M 4.2.1.2.1.2	Attack preparation and briefing	Provided clear briefing IAW appropriate directives.	Tactics/ weapons selection appropriate to situation	AFI 11-2A/OA-10, Volume 2, 1998
M 4.2.1.2.1.3	Target marking and description	Accurate and timely marking accomplished.	Fighters understood location of the specific target.	AFI 11-2A/OA-10, Volume 2, 1998
M 4.2.1.2.1.4	Observation position	Could clearly observe target and CAS aircraft during all phases of attack.	Remained within maneuvering parameters. Did not unnecessarily jeopardize aircraft.	AFI 11-2A/OA-10, Volume 2, 1998
M 4.2.1.2.1.5	Attack control	Exercised positive control of fighters throughout mission.	Provided clear, timely, accurate ordnance adjustment instructions and attack clearance to each aircraft.	AFI 11-2A/OA-10, Volume 2, 1998
M 4.2.1.2.1.6	Post attack procedures	Provided accurate assessment and concise report	Provided the fighters and appropriate agencies a concise report in accordance with the governing directives.	AFI 11-2A/OA-10, Volume 2, 1998
M 4.2.1.2.1.7	Visual reconnaissance	Identified appropriate elements of information	Minimized threat exposure. Preserved operational security.	AFI 11-2A/OA-10, Volume 2, 1998
M 4.2.1.2.1.8	Rendezvous	Effected rendezvous where threat permitted with timely holding instructions		AFI 11-2A/OA-10, Volume 2, 1998
M 4.2.1.2.1.9	Target area identification	Acquired the target and positively confirmed target and friendly location expeditiously		AFI 11-2F-16, Volume 2, 1998
<b>4.2.1.2.2</b>	<b>AIR STRIKE CONTROL (ASC) (NO COMPARABLE AFT – AFI 11-2F16)</b>			
M 4.2.1.2.2.1	Map reading/target plotting	Degree of accuracy sufficient for efficient target neutralization		AFI 11-2F-16, Volume 1, 1998
M 4.2.1.2.2.2	Authentication	100% confirmation prior to information transfer		AFI 11-2F-16, Volume 1, 1998

Number	MOP/MOE	Definition (if needed)	Criteria (if needed)	Reference
M 4.2.1.2.2.2	ASC coordination			AFI 11-2F-16, Volume 1, 1998
M 4.2.1.2.2.4	Fighter-to-FAC and FAC-to-Fighter briefs	Concise, efficient and adequate transfer of information		AFI 11-2F-16, Volume 1, 1998
M 4.2.1.2.2.5	Fighter rendezvous/control	Efficient and safe		AFI 11-2F-16, Volume 1, 1998
M 4.2.1.2.2.6	Target plotting/ID/markings	Timely location and useful marks		AFI 11-2F-16, Volume 1, 1998
M 4.2.1.2.2.7	Observation position	In position to observe all players but clear of known threats		AFI 11-2F-16, Volume 1, 1998
M 4.2.1.2.2.8	Threat avoidance			AFI 11-2F-16, Volume 1, 1998
M 4.2.1.2.2.9	Binocular use	No compromise of aircraft control or safety during use		AFI 11-2F-16, Volume 1, 1998
M 4.2.1.2.2.10	Battle damage assessment	Accurate and timely		AFI 11-2F-16, Volume 1, 1998
M 4.2.1.2.2.11	Operation in a comm jamming environment	Able to continue mission with presence of jamming		AFI 11-2F-16, Volume 1, 1998
M 4.2.1.2.2.12	Troops-in-contact scenario	Protection of friendlies and destruction of enemy without fratricide		AFI 11-2F-16, Volume 1, 1998
M 4.2.1.2.2.13	Collateral damage control	Minimization if not elimination		AFI 11-2F-16, Volume 1, 1998
M 4.2.1.2.2.14	Laser target verification/markings			AFI 11-2F-16, Volume 1, 1998
M 4.2.1.2.2.15	Medium threat attack restrictions			AFI 11-2F-16, Volume 1, 1998
M 4.2.1.2.2.16	Buddy lasing	Adequate and timely for weapon limitations		AFI 11-2F-16, Volume 1, 1998
M 4.2.1.2.2.17	Artillery coordination	Call for as required and deconflicted when necessary		AFI 11-2F-16, Volume 1, 1998
<b>4.2.1.3</b>	<b><i>Airborne operations measures (AFT 4.2.1.3)</i></b>			
M 4.2.1.3.1	Time to perform airborne operations			AFT 4.2.1.3, M 1 (AFDD 1-1, Aug 98)
M 4.2.1.3.2	Distance from desired location for force placement or position.			AFT 4.2.1.3, M 2 (AFDD 1-1, Aug 98)
M 4.2.1.3.3	Number of troops, supplies, and equipment moved in joint airborne operations			AFT 4.2.1.3, M 3 (AFDD 1-1, Aug 98)
M 4.2.1.3.4	Cost to perform airborne operations			AFT 4.2.1.3, M 4 (AFDD 1-1, Aug 98)
<b>4.2.1.4</b>	<b><i>Amphibious operations measures (AFT 4.2.1.4)</i></b>			
M 4.2.1.4.1	Percent of total effort invested in supporting the delivery of troops, supplies, and equipment in joint amphibious operations			AFT 4.2.1.4, M 1 (AFDD 1-1, Aug 98)
M 4.2.1.4.2	Number of troops, supplies, and equipment moved in joint amphibious operations			AFT 4.2.1.4, M 2 (AFDD 1-1, Aug 98)
M 4.2.1.4.3	Cost to support amphibious operations			AFT 4.2.1.4, M 3 (AFDD 1-1, Aug 98)
<b>4.3</b>	<b><i>Counter-sea capability (AFT 4.3)</i></b>			
M 4.3.1	Percent of forces organized for countersea operations.			AFT 4.3, M 1 (AFDD 1-1, Aug 98)
M 4.3.2	Percent of forces equipped for countersea operations.			AFT 4.3, M 2 (AFDD 1-1, Aug 98)
M 4.3.3	Percent of forces trained for countersea operations.			AFT 4.3, M 3 (AFDD 1-1, Aug 98)
M 4.3.4	Percent of requested forces provided for countersea.			AFT 4.3, M 3 (AFDD 1-1, Aug 98)

Number	MOP/MOE	Definition (if needed)	Criteria (if needed)	Reference
M 4.3.5	Percent of effective prosecution of countersea operations.			AFT 4.3, M 4 (AFDD 1-1, Aug 98)
<b>4.3.1</b>	<b>Counter-sea operations (AFT 4.3.1)</b>			
M 4.3.1.1	Percent of enemy maritime forces detected and identified			AFT 4.3.1, M 1 (AFDD 1-1, Aug 98)
M 4.3.1.2	Percent of enemy maritime forces destroyed or neutralized			AFT 4.3.1, M 2 (AFDD 1-1, Aug 98)
M 4.3.1.3	Percent of friendly forces and materiel protected from enemy maritime operations.			AFT 4.3.1, M 3 (AFDD 1-1, Aug 98)
M 4.3.1.4	Cost to perform counter-sea functions			AFT 4.3.1, M 4 (AFDD 1-1, Aug 98)
<b>4.3.1.1</b>	<b>Interdict enemy sea power (AFT 4.3.1.1)</b>			
M 4.3.1.1.1	Percent of desired strategic effects achieved			AFT 4.3.1.1, M 1 (AFDD 1-1, Aug 98)
M 4.3.1.1.2	Percent of desired strategic effects achieved			AFT 4.3.1.1, M 2 (AFDD 1-1, Aug 98)
M 4.3.1.1.3	Percent of desired tactical effects achieved			AFT 4.3.1.1, M 3 (AFDD 1-1, Aug 98)
M 4.3.1.1.4	Percent of enemy C2 systems, personnel, materiel, logistics, and/or supporting systems disrupted, delayed, or destroyed			AFT 4.3.1.1, M 4 (AFDD 1-1, Aug 98)
M 4.3.1.1.5	Number of sorties required to achieve desired effects			AFT 4.3.1.1, M 5 (AFDD 1-1, Aug 98)
M 4.3.1.1.6	Time to achieve desired effects.			AFT 4.3.1.1, M 6 (AFDD 1-1, Aug 98)
M 4.3.1.1.7	Cost to interdict enemy sea power			AFT 4.3.1.1, M 7 (AFDD 1-1, Aug 98)
<b>4.3.1.2</b>	<b>Anti-submarine operations (AFT 4.3.1.2)</b>			
M 4.3.1.2.1	Percent of desired strategic effects achieved			AFT 4.3.1.2, M 1 (AFDD 1-1, Aug 98)
M 4.3.1.2.2	Percent of desired operational effects achieved			AFT 4.3.1.2, M 2 (AFDD 1-1, Aug 98)
M 4.3.1.2.3	Percent of desired tactical effects achieved			AFT 4.3.1.2, M 3 (AFDD 1-1, Aug 98)
M 4.3.1.2.4	Number of enemy submarines successful degraded			AFT 4.3.1.2, M 4 (AFDD 1-1, Aug 98)
M 4.3.1.2.5	Number of sorties required to achieve desired effects.			AFT 4.3.1.2, M 5 (AFDD 1-1, Aug 98)
M 4.3.1.2.6	Time to achieve desired effects			AFT 4.3.1.2, M 6 (AFDD 1-1, Aug 98)
M 4.3.1.2.7	Cost to conduct antisubmarine warfare.			AFT 4.3.1.2, M 7 (AFDD 1-1, Aug 98)
<b>4.3.1.3</b>	<b>Aerial minelaying operations (AFT 4.3.1.3)</b>			
M 4.3.1.3.1	Percent of desired strategic effects achieved			AFT 4.3.1.3, M 1 (AFDD 1-1, Aug 98)
M 4.3.1.3.2	Percent of desired operational effects achieved			AFT 4.3.1.3, M 2 (AFDD 1-1, Aug 98)

Number	MOP/MOE	Definition (if needed)	Criteria (if needed)	Reference
M 4.3.1.3.3	Percent of desired tactical effects achieved			AFT 4.3.1.3, M 3 (AFDD 1-1, Aug 98)
M 4.3.1.3.4	Time to achieve desired effects			AFT 4.3.1.3, M 4 (AFDD 1-1, Aug 98)
M 4.3.1.3.5	Number of sorties required to achieve desired effects			AFT 4.3.1.3, M 5 (AFDD 1-1, Aug 98)
M 4.3.1.3.6	Cost to conduct interdiction.			AFT 4.3.1.3, M 6 (AFDD 1-1, Aug 98)
<b>4.4</b>	<b><i>Special operations forces (AFT 4.4)</i></b>			
M 4.4.1	% destruction of enemy logistics required by operational forces.			HQ USAF/XOOT, 1997
M 4.4.2	% increase in friendly options (following interdiction).			HQ USAF/XOOT, 1997
M 4.4.3	% of attacks have collateral damage within limits defined by NCA or theater commander			HQ USAF/XOOT, 1997
M 4.4.4	% of enemy forces or materials diverted, disrupted, delayed or destroyed before effective use against friendly forces.			HQ USAF/XOOT, 1997
M 4.4.5	% of enemy operational forces diverted, disrupted, delayed or destroyed outside AOR/theater of operations.			HQ USAF/XOOT, 1997
M 4.4.6	% of enemy operational targets engaged.			HQ USAF/XOOT, 1997
M 4.4.7	% of potential enemy COAs denied.			HQ USAF/XOOT, 1997
M 4.4.8	% of target attacks achieving desired effects.			HQ USAF/XOOT, 1997
M 4.4.9	% reduction of enemy LOC capacity required for offensive operations.			HQ USAF/XOOT, 1997
<b>5</b>	<b><i>GLOBAL MOBILITY (AFT 5)</i></b>			
<b>5.1</b>	<b><i>Airlift Capabilities (AFT 5.1)</i></b>			
M 5.1.1	% of forces organized for air transport for armed forces.			AFT 5.1, M 1 (AFDD 1-1, Aug 98)
M 5.1.2	% of forces trained for air transport for armed forces.			AFT 5.1, M 2 (AFDD 1-1, Aug 98)
M 5.1.3	% of forces equipped for air transport for armed forces.			AFT 5.1, M 3 (AFDD 1-1, Aug 98)
M 5.1.4	% of requested forces provided for air transport for armed forces.			AFT 5.1, M 4 (AFDD 1-1, Aug 98)
M 5.1.5	Degree to which forces are capable of air transport for the armed forces.			AFT 5.1, M 5 (AFDD 1-1, Aug 98)
M 5.1.6	% of repairables movement by retrograde aircraft (aircraft do not deviate from schedule missions)			HQ USAF/XOOT, 1997

Number	MOP/MOE	Definition (if needed)	Criteria (if needed)	Reference
M 5.1.7	Incidents attributed to navigational errors (near miss, contact with enemy, etc.) <i>*Cross reference to Air Combat Measures</i>			UNTL, 1996, p. 185
M 5.1.8	Incidents of navigational errors due to equipment malfunctions <i>*Cross reference to Air Combat Measures.</i>			UNTL, 1996, p. 185
M 5.1.9	Incidents of navigational errors due to inadequate maps/charts <i>*Cross reference to Air Combat Measures.</i>			UNTL, 1996, p. 185
M 5.1.10	Incidents of navigational errors due to training <i>*Cross reference to Air Combat Measures.</i>			UNTL, 1996, p. 185
M 5.1.11	Mishaps attributed to navigational errors (accidents) <i>*Cross reference to Air Combat Measures.</i>			UNTL, 1996, p. 185
M 5.1.12	% of sourced airlift aircraft mission capable by planned deployment date			UJTL, 1996, p. 4-8
M 5.1.13	% of Sourced Tanker Aircraft mission capable by planned deployment date			UJTL, 1996, p. 4-8
M 5.1.14	On-schedule take-off time <i>*Cross reference to Maintenance Delivery Measures</i>	Each aircraft must depart home station in accordance with the published schedule or no later than the latest time for mission completion.		AMCI 90-201 (AMC/IGPS, 1996)
M 5.1.15	% of strategic airlift assets on schedule			UJTL, 1996, p. 4-7
M 5.1.16	Hours to reconfigure an airlift aircraft for AE use.			HQ USAF/XOOT, 1997
M 5.1.17	Hours to load aircraft			UJTL, 1996, p. 4-8
M 5.1.18	Ability to land on snow <i>*Cross reference to Air Combat measures</i>			ACC/DRS, 1995b, p. 20; ASC/XRR, 1996
M 5.1.19	Hours to unload aircraft			UJTL, 1996, p. 4-8
M 5.1.20	Airdrop accuracy	For effective personnel & equipment load drops, the object must land within the specified size drop zone.		AFI 90-201/ACC SUP 1 (ACC/IGIX, 1996); AFI 90-201/AFSOC SUP 1 (AFSOC/IG, 1995); AMCI 90-201 (AMC/IGPS, 1996); MIL-STD-1776A, 1994, p. 54
M 5.1.21	% of drops in zone			UNTL, 1996, p. 219
M 5.1.22	Hours to deploy Forward Air Controller (AC)			HQ USAF/XOOT, 1997
M 5.1.23	Days until arrival of first PSYOPs units in theater (after initial landings)			HQ USAF/XOOT, 1997
M 5.1.24	Hours to evacuate noncombatants (once commander-in-chief (CINC) directed to conduct evacuation)			HQ USAF/XOOT, 1997
M 5.1.25	% of missions successful in deploying cargo/troops			HQ USAF/XOOT, 1997
M 5.1.26	Days delay of frustrated (i.e., not moving) cargo			HQ USAF/XOOT, 1997

Number	MOP/MOE	Definition (if needed)	Criteria (if needed)	Reference
M 5.1.27	Hours maximum lag in high priority cargo ITV			HQ USAF/XOOT, 1997
M 5.1.28	Hours lag in high priority cargo ITV			HQ USAF/XOOT, 1997
M 5.1.29	% of cargo/troops successfully deployed			HQ USAF/XOOT, 1997
M 5.1.30	Hours to rig equipment or supplies for airdrop in theater of operations/AOR			HQ USAF/XOOT, 1997
M 5.1.31	Number of personnel that can be rigged for a single airdrop			HQ USAF/XOOT, 1997
M 5.1.32	Tons of equipment can be rigged for a single airdrop			HQ USAF/XOOT, 1997
M 5.1.33	Million ton miles per day (MTM/D)	An aggregate, unconstrained measure of airlift capacity used as a top-level comparative metric.		AMC/XP, 1995, p. 1-23; AMC/XP, 1996, p. 1-23
M 5.1.34	Air refueling	Unit's ability to provide air refueling services to users.		ACC/DRS, 1995b, p. 19; AFI 90-201/AFSOC SUP 1 (AFSOC/IG, 1995); AMCI 90-201 (AMC/IGPS, 1996); AMC/XP, 1995; AMC/XP, 1996; ASC/XRR, 1996; Turner & Bard, 1972, p. 5
M 5.1.35	% of aircraft, diverted from planned destination (missed aerial refueling)			HQ USAF/XOOT, 1997
M 5.1.36	% of airlift sorties that must stop enroute because of lack of tanker support			HQ USAF/XOOT, 1997
M 5.1.37	% of bomber combat missions, diverted or canceled for lack of tanker support			HQ USAF/XOOT, 1997
M 5.1.38	% of fighter deployments (USAF, USN, or USMC) that must use en route stops (lack of tanker support)			HQ USAF/XOOT, 1997
M 5.1.39	% of receiver aircraft that must divert (tankers missing air refueling control times)			HQ USAF/XOOT, 1997
M 5.1.40	% of tanker packages (UTCs/ULNs) completing scheduled offload			HQ USAF/XOOT, 1997
M 5.1.41	% of tanker packages, (UTCs/ULNs), meeting LAD			HQ USAF/XOOT, 1997
M 5.1.42	% of receivers diverted (due to lack of refueling)			HQ USAF/XOOT, 1997
M 5.1.43	Refueling Time			Cooper, 1996; JAST, 1995; Turner & Bard, 1972, p. 5
M 5.1.44	Pounds of fuel transferred during air refueling			UNTL, 1996, p. 210
M 5.1.45	Gallons of fuel lost to enemy action			UNTL, 1996, p. 210
M 5.1.46	Gallons of fuel lost to spills			UNTL, 1996, p. 210

Number	MOP/MOE	Definition (if needed)	Criteria (if needed)	Reference
M 5.1.47	<b>Aircrew manning ratios</b> <i>*Cross reference to Air Combat, &amp; Performance Capabilities measures.</i>	Sortie generation capability is affected by low manning ratios and low Optempo. Air Reserve Component (ARC), US Air Forces in Europe (USAFE), & Pacific Air Forces (PACAF) aircrew manning ratios are lower than those of ACC units, which does not allow them to sustain operations at the same Optempo. Therefore, warfighting CINCs will not receive the same sortie generation capability from non-ACC units.		ACC/DRS, 1995a, p. 36
M 5.1.48	<b>Threat detection</b> <i>*Cross reference to Air Combat measures.</i>	Degree to which aircraft system can detect hostile air and ground threats.		ACC/DRS, 1995a, p. 33
M 5.1.49	<b>Hours to reroute airlift flow around new threats</b>			UJTL, 1996, p. 4-7
M 5.1.50	<b>% increase in distance traveled due to obstacles</b> <i>*Cross reference to Air Combat measures.</i>			UNTL, 1996, p. 187
M 5.1.51	<b>% reduction in average speed of movement due to obstacles</b> <i>*Cross reference to Air Combat measures.</i>			UNTL, 1996, p. 187
M 5.1.52	<b>% of casualties suffered while overcoming or bypassing obstacles</b> <i>Cross reference to Air Combat measures.</i>			UNTL, 1996, p. 187
M 5.1.53	<b>% of strategic airlift/tanker deployment missions delayed, diverted, rerouted, or canceled due to threats, climate, or geography.</b>			UJTL, 1996, p. 4-7
M 5.1.54	<b>% of strategic airlift assets lost, delayed, diverted, changed, or canceled due to threats, climate, or geography.</b>			UJTL, 1996, p. 4-7
M 5.1.55	<b>% of strategic airlift/tanker deployment aircraft destroyed by hostile enemy action.</b> <i>*Cross reference to Flight Detectability/Survivability/Vulnerability measures</i>			UJTL, 1996, p. 4-7
M 5.1.56	<b>Airdrop accuracy</b>	Distance from designated drop point		Rodeo (US Transportation Command tanker/airlift competition)
M 5.1.57	<b>Aircrew "alert" times</b>	Response time to scramble launch order		Rodeo (US Transportation Command tanker/airlift competition)
M 5.1.58	<b>Aerial refueling</b>	Receiving and off-loading aircraft rated by timing and accuracy navigating to the air refueling point		Rodeo (US Transportation Command tanker/airlift competition)
M 5.1.59	<b>Shortfield landing</b>	Ability to land on short or unimproved airfield		Rodeo (US Transportation Command tanker/airlift competition)
M 5.1.60	<b>Navigation</b>	Accuracy of navigational skill during aerial refueling using no more than three radar fixes		Rodeo (US Transportation Command tanker/airlift competition)

Number	MOP/MOE	Definition (if needed)	Criteria (if needed)	Reference
M 5.1.61	Combat control	Combat and technical skills expected for mission accomplishment		Rodeo (US Transportation Command tanker/airlift competition)
<b>5.1.1</b>	<b>Perform Airlift (AFT 5.1.1)</b>			
M 5.1.1.1	Time to air transport selected forces.			AFT 5.1.1, M 1 (AFDD 1-1, Aug 98)
M 5.1.1.2	Degree of capability to air transport armed forces			AFT 5.1.1, M 2 (AFDD 1-1, Aug 98)
M 5.1.1.3	Percent of personnel and materiel transported through the air.			AFT 5.1.1, M 3 (AFDD 1-1, Aug 98)
M 5.1.1.4	Number of personnel and materiel transported through the air.			AFT 5.1.1, M 4 (AFDD 1-1, Aug 98)
M 5.1.1.5	Cost to perform airlift			AFT 5.1.1, M 5 (AFDD 1-1, Aug 98)
<b>5.2</b>	<b>Provide air refueling capability (AFT 5.2)</b>			
M 5.2.1	Percent of forces organized for the in-flight refueling support of the operations and deployments of aircraft of the Air Force and other Services as directed.			AFT 5.2, M 1 (AFDD 1-1, Aug 98)
M 5.2.2	Percent of forces trained for the in-flight refueling support of the operations and deployments of aircraft of the Air Force and other Services as directed.			AFT 5.2, M 2 (AFDD 1-1, Aug 98)
M 5.2.3	Percent of forces equipped for the in-flight refueling support of the operations and deployments of aircraft of the Air Force and other Services as directed.			AFT 5.2, M 3 (AFDD 1-1, Aug 98)
M 5.2.4	Percent of requested forces provided for the in-flight refueling support of the operations and deployments of aircraft of Air Force and other Services as directed.			AFT 5.2, M 4 (AFDD 1-1, Aug 98)
M 5.2.5	Degree to which forces are capable of in-flight refueling support of operations and deployments of aircraft of the Air Force and other Services as directed.			AFT 5.2, M 5 (AFDD 1-1, Aug 98)
<b>5.2.1</b>	<b>Perform air refueling (AFT 5.2.1)</b>			
M 5.2.1.1	Time for in-flight refueling support to be performed.			AFT 5.2.1, M 1 (AFDD 1-1, Aug 98)
M 5.2.1.2	Percent of the operations and deployments of aircraft of the Air Force and other Services receiving in-flight refueling support			AFT 5.2.1, M 2 (AFDD 1-1, Aug 98)
M 5.2.1.3	Number of the operations and deployments of aircraft of the Air Force and other Services receiving in-flight refueling support			AFT 5.2.1, M 3 (AFDD 1-1, Aug 98)

Number	MOP/MOE	Definition (if needed)	Criteria (if needed)	Reference
M 5.2.1.4	Cost to perform in-flight refueling support			AFT 5.2.1, M 4 (AFDD 1-1, Aug 98)
<b>5.3</b>	<b>Strategic and Theater Aeromedical Evacuation (AE) (AFT 5)</b>			
	[to be added]			
<b>6</b>	<b>Tactical employment (No comparable AFT, AFI 11-2F-16 and AFI 11-2A/OA-10)</b>			
<b>6.1</b>	<b>General tactical measures (No comparable AFT, AFI 11-2F-16 and AFI 11-2A/OA-10)</b>			
M 6.1.1	Development of sound tactical plan	Include mission objectives, known threats and flight member capabilities		AFI 11-2A/OA-10, Volume 2, 1998
M 6.1.2	Sound execution of tactical plan	Applied tactics consistent with the threat, current directives, and good judgment. Executed the plan and achieved mission goals. Quickly adapted to changing environment. Maintained situational awareness		AFI 11-2A/OA-10, Volume 2, 1998
M 6.1.3	GCI/AWACS interface	Planned and used effectively to enhance and achieve mission objectives. No confusion between GCI/AWACS/Composite Force Assets and fighters		AFI 11-2A/OA-10, Volume 2, 1998
M 6.1.4	Radio transmission - Usage and discipline		Radio communications were concise, accurate and effectively used to direct maneuvers or describe the tactical situation	AFI 11-2F-15E, Volume 2, DRAFT
M 6.1.5	Visual lookout/Radar search	Demonstrated thorough knowledge and effective application of visual lookout/radar search techniques for all phases of flight		AFI 11-2A/OA-10, Volume 2, 1998
M 6.1.6	Mutual support	Maintained during entire mission and sustained offensive posture and /or negated all attacks		AFI 11-2A/OA-10, Volume 2, 1998
M 6.1.7	Tactical navigation	Remained geographically oriented throughout mission following appropriate altitude and airspace restrictions		AFI 11-2A/OA-10, Volume 2, 1998
M 6.1.8	Ingress	Aware of all known/simulated factor threats and defenses. Employed effective use of evasive maneuvers and terrain masking and/or route and altitude selection.		AFI 11-2A/OA-10, Volume 2, 1998
M 6.1.9	Egress	Effectively used evasive maneuvers and terrain masking to complete an expeditious egress from the target area. Flight/element join-up was accomplished as soon as possible without undue exposure to enemy defenses		AFI 11-2A/OA-10, Volume 2, 1998
M 6.1.10	Combat separation	Adhered to briefed/directed separation procedures. Positive control of flight/element during separation. Maintained mutual support with adversary unable to achieve valid simulated missile/gun firing parameters		AFI 11-2F-16, Volume 2, 1998

Number	MOP/MOE	Definition (if needed)	Criteria (if needed)	Reference
M 6.1.11	Threat reactions		Threat reactions were timely and correct. Accomplished appropriate countermeasures and performed maneuvers to counter threat	AFI 11-2A/OA-10, Volume 2, 1998
M 6.1.12	Delivery of accurate, timely inflight report			AFI 11-2A/OA-10, Volume 2, 1998
M 6.1.13	ECM/ECCM/IRCM/RWR usage	Proper interpretation of threat scope aural tones, warning lights and chaff/ECM operation		AFI 11-2A/OA-10, Volume 2, 1998
M 6.1.14	Timing- 1	Conventional attack- ordnance impact	+ _ 1 minute of preplanned TOT	AFI 11-2F-16, Volume 2, 1998
M 6.1.15	Timing- 2	SEAD/DCA- vulnerability period	+ _ 1 minute of beginning of vul. time. Covered TOT window	AFI 11-2F-16, Volume 2, 1998
M 6.1.16	Timing- 3	RECCE- Preplanned TOT	+ _ 1 minute of preplanned TOT	AFI 11-2F-16, Volume 2, 1998
M 6.1.17	Timing- 4	OCA /Sweep/Cap- Push time	Arrival on station not more than 1 minute late	AFI 11-2F-16, Volume 2, 1998
M 6.1.18	Timing -5	Low level strike -Nuclear	+ _ 30 seconds of preplanned TOD	AFI 11-2F-16, Volume 2, 1998
M 6.1.19	Terrain Following Radar (TFR) procedures		Followed all prescribed procedures and performed all TFR system checks correctly prior to beginning TFR operations	AFI 11-2F-15E, Volume 2, DRAFT
M 6.1.20	Electronic attack/electronic protection/all aspect missile defense EA/EP/AAMD		Interpretation of threat scope aural tones, warning lights and operation of TFWS systems, indicated thorough knowledge and timely application	AFI 11-2F-15E, Volume 2, DRAFT
M 6.1.21	Weapons system utilization		Correctly utilized the weapon system to deliver the desired ordnance (actual or simulated). Executed all required procedures to successfully employ the weapon.	AFI 11-2F-15E, Volume 2, DRAFT
<b>6.2</b>	<b><i>Air-to-surface measures (No comparable AFT, AFI 11-2F-16 , AFI 11-2A/OA-10 and AFI 11-2F-15E DRAFT)</i></b>			
M 6.2.1	Target acquisition	Target acquired on the first attack or, if missed due to difficult target identification features, a successful reattack was accomplished. For multiple target scenarios, all targets were acquired on the first attack or with a successful reattack		AFI 11-2F-16, Volume 2, 1998 AFI 11-2F-15E, Volume 2, DRAFT
M 6.2.2	Tactical attack	Demonstrated complete knowledge of weapons delivery procedures, attack parameters, and weapons computations for the events performed. Bomb Score was within hit criteria.		AFI 11-2F-16, Volume 2, 1998 AFI 11-2F-15E, Volume 2, DRAFT
M 6.2.3	Air-to-surface weapons employment	Demonstrated complete knowledge of weapons delivery procedures, attack parameters and weapons computation		AFI 11-2A/OA-10, Volume 2, 1998 AFI 11-2F-15E, Volume 2, DRAFT

Number	MOP/MOE	Definition (if needed)	Criteria (if needed)	Reference
M 6.2.4	<b>IR sensor operation</b>	Demonstrated adequate working knowledge and capability	Correctly operated the sensor to acquire the target. Was able to properly tune the sensor display to permit weapons delivery	AFI 11-2A/OA-10, Volume 2, 1998 AFI 11-2F-15E, Volume 2, DRAFT
M 6.2.5	<b>Precision Guided Munitions (PGM) delivery procedures</b>	Correctly released the PGM at the planned delivery parameters. Used proper lasing procedures to optimally guide the PGM. Followed all current procedures and guidance during the PGM delivery and recovery.		AFI 11-2F-16, Volume 2, 1998 AFI 11-2F-15E, Volume 2, DRAFT
M 6.2.6	<b>Threat detection</b>	Timely acquisition of all threats		AFI 11-2F-16, Volume 1, 1998
M 6.2.7	<b>Defensive reactions</b>	Proper reaction to negate and /or defeat encountered threats		AFI 11-2F-16, Volume 1, 1998 AFI 11-2F-15E, Volume 2, DRAFT
M 6.2.8	<b>Weapons system utilization</b>	Correctly utilized the weapon system to deliver the desired ordnance (actual or simulated). Executed all required procedures to successfully employ the weapon		AFI 11-2F-16, Volume 1, 1998 AFI 11-2F-15E, Volume 2, DRAFT
M 6.2.9	<b>Radar search/sorting technique</b>	Demonstrated satisfactory knowledge and effective application of radar search/sorting techniques for all phases of flight. Recognized chaff/EA and compensated for lock transfer. Utilized radar, with proper EP techniques, to maximum extent possible		AFI 11-2F-16, Volume 1, 1998 AFI 11-2F-15E, Volume 2, DRAFT
<b>6.3</b>	<b><i>Surface attack / surface attack tactics and measures (No comparable AFT, AFI 11-2F-16 and AFI 11-2A/OA-10)</i></b>			
M 6.3.1	<b>Route/threat planning</b>	Plan optimal route		AFI 11-2F-16, Volume 1, 1998
M 6.3.2	<b>Timing control</b>	Manage aircraft and /or flight to arrive over target on time		AFI 11-2F-16, Volume 1, 1998
M 6.3.3	<b>Medium/low altitude ingress</b>			AFI 11-2F-16, Volume 1, 1998
M 6.3.4	<b>Inflight report</b>	Timely, accurate reporting of mission results		AFI 11-2F-16, Volume 1, 1998
M 6.3.5	<b>Authentication procedures</b>	Proper verification of identity of all players		AFI 11-2F-16, Volume 1, 1998
M 6.3.6	<b>Safe recovery procedures</b>	Follow established procedures		AFI 11-2F-16, Volume 1, 1998
M 6.3.7	<b>First-look attack</b>	Successful attack against target not previously encountered		AFI 11-2F-16, Volume 1, 1998
M 6.3.8	<b>Tactical egress</b>			AFI 11-2F-16, Volume 1, 1998
M 6.3.9	<b>Comm jam procedures</b>	Effectively accomplish mission in jamming environment		AFI 11-2F-16, Volume 1, 1998
<b>6.4</b>	<b><i>Air-to-Ground Gunnery Events and Measures (No comparable AFT, AFI 11-2F-16 and AFI 11-2A/OA-10)</i></b>			
M 6.4.1	<b>Low angle strafe (LAS)</b>		Hit criteria: 25 percent (total hits divided by actual rounds fired or 50 rounds whichever is greater)	AFI 11-2F-16, Volume 1, 1998
M 6.4.2	<b>High angle strafe (HAS)</b>		Hit criteria: On any pass, bullet dispersion within 75 feet of point target with independently observed impacts on the target.	AFI 11-2F-16, Volume 1, 1998

Number	MOP/MOE	Definition (if needed)	Criteria (if needed)	Reference
M 6.4.3	<b>Two target strafe (TTS).</b>		Hit criteria: 4 separate impacts out of 6 total attempts (3 long/3 Short) on two targets (minimum of 1 round fired on each target per pass).	AFI 11-2F-16, Volume 1, 1998
M 6.4.4	<b>Long range strafe (LRS).</b>		Hit criteria: 5 acoustically scored impacts or independently observed impacts (suitable target) on any pass.	AFI 11-2F-16, Volume 1, 1998
M 6.4.5	<b>Loft event</b>	A low altitude climbing delivery using appropriate aircraft systems for target acquisition, tracking, and weapons release while maximizing standoff range or weapons effects.	Hit criteria: 750 feet (229m).	AFI 11-2F-16, Volume 1, 1998
M 6.4.6	<b>Visual level</b>	A delivery with less than five degrees of climb or dive at weapons release (non-maneuvering) using any means of delivery with visual target acquisition/designation.	Hit criteria: 130 feet (40m).	AFI 11-2F-16, Volume 1, 1998
M 6.4.7	<b>Systems level</b>	A delivery with less than five degrees of climb or dive at weapons release (non-maneuvering) using any means of delivery without visual target acquisition/designation	Hit criteria: 195 feet (60m).	AFI 11-2F-16, Volume 1, 1998
M 6.4.8	<b>Low angle high drag (LAHD)</b>	Dive angle is less than 30 degrees employing retarded weapons	Hit criteria: 75 feet (23m) for computed deliveries; 105 feet (32m) for manual; or within the target area or impacting the vertical panel in the skip target	AFI 11-2F-16, Volume 1, 1998
M 6.4.9	<b>Low angle low drag (LALD)</b>	Dive angle is less than 30 degrees using free fall weapons	Hit criteria: 100 feet (31m) for computed deliveries; 175 feet (53m) for manual.	AFI 11-2F-16, Volume 1, 1998
M 6.4.10	<b>Dive bomb (DB)</b>	Dive angle is 30 degrees or greater	Hit criteria: 85 feet (26m) for computed deliveries; 145 feet (44m) for manual.	AFI 11-2F-16, Volume 1, 1998
M 6.4.11	<b>High altitude dive bomb (HADB)</b>	Dive angle is 30 degrees or greater. Minimum recovery altitude is 4,500 feet AGL	Hit criteria: 125 feet (38m) for computed deliveries; 250 feet (76m) for manual.	AFI 11-2F-16, Volume 1, 1998
	<b>Maverick employment: Mission objectives</b>			AFI 11-2F-16, Volume 1, 1998
M 6.4.12	<b>System operating limitations</b>	Possesses adequate knowledge for satisfactory mission performance		AFI 11-2F-16, Volume 1, 1998
M 6.4.13	<b>Switchology</b>	Knowledge of correct switch actuation order		AFI 11-2F-16, Volume 1, 1998
M 6.4.14	<b>Boresight check</b>	Verification of systems alignment accuracy prior to engagement		AFI 11-2F-16, Volume 1, 1998
M 6.4.15	<b>Acquisition, track, and launch techniques</b>			AFI 11-2F-16, Volume 1, 1998
M 6.4.16	<b>Maximum standoff range launches.</b>	Recognition of and proper employment at max range envelope		AFI 11-2F-16, Volume 1, 1998

Number	MOP/MOE	Definition (if needed)	Criteria (if needed)	Reference
M 6.4.17	Track and launch parameters			AFI 11-2F-16, Volume 1, 1998
M 6.4.18	Element attack procedures and tactics			AFI 11-2F-16, Volume 1, 1998
M 6.4.19	Tactical maneuvering			AFI 11-2F-16, Volume 1, 1998
M 6.4.20	Ordnance limitations	Knowledge and use of ordnance delivery restrictions		AFI 11-2F-16, Volume 1, 1998
M 6.4.21	Attacks against preplanned targets			AFI 11-2F-16, Volume 1, 1998
M 6.4.22	Attacks against targets of opportunity			AFI 11-2F-16, Volume 1, 1998
M 6.4.23	AGM-65 Maverick	A delivery initiated from a level, diving, or pop-up maneuver to achieve line-of-sight to the target(s). Acquisition, missile lock-on and launch, or 2 seconds stable lock-on in "No launch" conditions, followed by a tactical escape maneuver is required	Hit criteria: Either actual target impact or valid, recorded TGM simulated weapon release within launch parameters with stabilized target tracking.	AFI 11-2F-16, Volume 1, 1998
M 6.4.24	Laser Guided Bomb (LGB)	An event using LANTIRN/aircraft systems to determine pull-up/release point and simulated/actual laser designation on the target	Hit criteria for LGB delivery profiles (with the exception of GBU-24) is: 33 feet (10m) for actual ordnance. Simulated deliveries will be scored a hit if the weapon was released within planned allowable parameters and a laser tracking accuracy of 1.8 miles during the last 8 seconds of flight is demonstrated	AFI 11-2F-16, Volume 1, 1998
M 6.4.25	Low Angle Rocket (LAR)	10 to 30 degrees dive angle; slant range 4,000 feet minimum	Hit criteria: 100 feet (30m).	AFI 11-2F-16, Volume 1, 1998
M 6.4.26	High Angle Rocket (HAR)	Dive angle of 30 degrees or greater	Hit criteria: 100 feet (30m).	AFI 11-2F-16, Volume 1, 1998
M 6.4.27	Low Altitude Tactical Rockets (LATR)	A tactical delivery from a dive angle of 0 to 30 degrees; slant range at release of 10,000 feet or greater from the target; minimum recovery altitude 1,000 feet AGL.	Hit criteria: 1000 feet (300m)	AFI 11-2F-16, Volume 1, 1998
M 6.4.28	High Altitude Tactical Rockets (HATR)	A tactical delivery from a dive angle of 0 to 30 degrees; slant range at release of 10,000 feet or greater from the target; minimum recovery altitude 4,000 feet AGL.	Hit criteria: 500 feet (152m)	AFI 11-2F-16, Volume 1, 1998
M 6.4.29	Loft Rockets (LR)	A tactical delivery from level to 45 degrees of climb; slant range at release of 10,000 feet or greater from the target; minimum recovery altitude 300 feet AGL.	Hit criteria: 1650 feet (500m).	AFI 11-2F-16, Volume 1, 1998
	Low Level Strike (LLS) Mission Objectives			AFI 11-2F-16, Volume 1, 1998
M 6.4.30	Strike mission planning			AFI 11-2F-16, Volume 1, 1998
M 6.4.31	First-run simulated strike delivery	Accurate weapon delivery against target previously unseen		AFI 11-2F-16, Volume 1, 1998
M 6.4.32	Visual and radar strike loft deliveries	Loft weapon delivery profile		AFI 11-2F-16, Volume 1, 1998
M 6.4.33	Visual and radar laydown deliveries	Level weapon delivery profile		AFI 11-2F-16, Volume 1, 1998
M 6.4.34	Emergency release procedures	Ability to release weapon with systems malfunction		AFI 11-2F-16, Volume 1, 1998

Number	MOP/MOE	Definition (if needed)	Criteria (if needed)	Reference
M 6.4.35	Min-risk departure and recovery	Following established safe corridors		AFI 11-2F-16, Volume 1, 1998
M 6.4.36	Execution message authentication			AFI 11-2F-16, Volume 1, 1998
	LANTIRN: Mission objectives			AFI 11-2F-16, Volume 1, 1998
M 6.4.37	Navigation and targeting pod operations/tuning			AFI 11-2F-16, Volume 1, 1998
M 6.4.38	FLIR trail departure	Flight navigation and formation using pod		AFI 11-2F-16, Volume 1, 1998
M 6.4.39	In-flight boresighting	Systems accuracy check prior to employment		AFI 11-2F-16, Volume 1, 1998
M 6.4.40	Station keeping	Ability to maintain desired object in field-of-view		AFI 11-2F-16, Volume 1, 1998
<b>6.5</b>	<b><i>Low-altitude tactical navigation (LATN) (No comparable AFT, AFI 11-2F-16 and AFI 11-2A/OA-10)</i></b>			
M 6.5.1	Dead reckoning	Navigation using time, distance and heading only		AFI 11-2F-16, Volume 1, 1998
M 6.5.2	Pilotage	Navigation using ground references and inferences		AFI 11-2F-16, Volume 1, 1998
M 6.5.3	INS use			AFI 11-2F-16, Volume 1, 1998
M 6.5.4	Vertical jink turns	Abrupt maneuvers as a defensive threat reaction		AFI 11-2F-16, Volume 1, 1998
M 6.5.5	Orthogonal SAM break	Abrupt maneuvers as a defensive threat reaction		AFI 11-2F-16, Volume 1, 1998
M 6.5.6	Ridge crossings	Crossing hilly terrain with minimum exposure		AFI 11-2F-16, Volume 1, 1998
M 6.5.7	Terrain masking	Using available natural terrain contours to hide aircraft radar signature		AFI 11-2F-16, Volume 1, 1998
M 6.5.8	EID/VID procedures	Use of instruments and eyeball to identify unknown target aircraft		AFI 11-2F-16, Volume 1, 1998
<b>6.6</b>	<b><i>Low-altitude tactical formation (LATF) (No comparable AFT, AFI 11-2F-16 and AFI 11-2A/OA-10)</i></b>			
M 6.6.1	Formations	Maintenance of assigned formation position		AFI 11-2F-16, Volume 1, 1998
M 6.6.2	Hazards at low altitudes	Knowledge and avoidance of ground hazards		AFI 11-2F-16, Volume 1, 1998
M 6.6.3	Tactical turns	Maintaining proper formation position during tactical maneuvering		AFI 11-2F-16, Volume 1, 1998
M 6.6.4	Visual lookout	Timely identification of threats		AFI 11-2F-16, Volume 1, 1998
M 6.6.5	Mutual support	Protection and defense of flight members		AFI 11-2F-16, Volume 1, 1998
M 6.6.6	Threat weapons systems envelopes	Knowledge of ranges of enemy weapons		AFI 11-2F-16, Volume 1, 1998
M 6.6.7	Defensive maneuvering against air-to-air and surface-to-air threats	Proper reaction to and negation of all threats encountered		AFI 11-2F-16, Volume 1, 1998
M 6.6.8	Flight member deconfliction	Awareness and avoidance of all other flight members		AFI 11-2F-16, Volume 1, 1998
M 6.6.9	Low altitude		Demonstrated satisfactory capability to adjust for deviations in time and course; only minor corrections required. Remained oriented within 2 NM of planned course or adjusted course and within route or airspace boundaries. Used terrain masking as circumstances allowed	AFI 11-2F-15C, Volume 2, 1998 DRAFT

Number	MOP/MOE	Definition (if needed)	Criteria (if needed)	Reference
<b>6.7</b>	<b>Killer scout tactics (No comparable AFT, AFI 11-2/F16)</b>			
M 6.7.1	Fluid maneuvering tactics	Deconfliction with all flight members		AFI 11-2F-16, Volume 1, 1998
M 6.7.2	Avionics use for obtaining target coordinates	Use of all available resources for coordinates		AFI 11-2F-16, Volume 1, 1998
M 6.7.3	Proper use of binoculars for visual recce	No compromise of aircraft or flight safety		AFI 11-2F-16, Volume 1, 1998
M 6.7.4	Locate and accurately mark a target			AFI 11-2F-16, Volume 1, 1998
M 6.7.5	Control multiple sets of fighters	Insure safe and timely target prosecution		AFI 11-2F-16, Volume 1, 1998
<b>6.8</b>	<b>Air-to-air and air-to-ground targeting (No comparable AFT)</b>			
M 6.8.1	Man-months of effort consumed in developing proposed target policy			UJTL, 1996, p. 4-22
M 6.8.2	Time to detect target	The time required to locate a target.		ASC/XRG, 1996, p.4-92; MIL-STD-1776A, 1994, p. 54
M 6.8.3	Time to identify target as a high priority target			UNTL, 1996, p. 203
M 6.8.4	% of targets accurately identified			UNTL, 1996, p. 196
M 6.8.5	% of targets accurately located			UNTL, 1996, p. 196
M 6.8.6	Ability to mark targets covertly or in adverse weather* <i>Cross reference to Air Combat measures</i>			ACC/DRC, 1995b, p. 20; ASC/XRG, 1996, p.4-93
M 6.8.7	Hours to assign firepower resources, once targets identified			UNTL, 1996, p. 203
M 6.8.8	# of hours to complete targeting cycle			UJTL, 1996, p. 4-73; UNTL, 1996, p. 203
M 6.8.9	% of target locations verified before next targeting cycle			UNTL, 1996, p. 201
M 6.8.10	# of minutes to attack target after most recent information on target provided			UJTL, 1996, p. 4-136
M 6.8.11	Time Over Target (TOT)	Based on the time the aircraft first enters the area, range, or other specified point approved by the Inspector General (IG).		AFI 90-201/ACC SUP 1 (ACC/IGIX, 1996); AFI 90-201/AFSOC SUP 1 (AFSOC/IG, 1995); AMCI 90-201 (AMC/IGPS, 1996); MIL-STD-1776A, 1994, p. 54
M 6.8.12	# of assigned targets engaged with firepower			UNTL, 1996, p. 192
M 6.8.13	% of high priority targets selected for attack			UNTL, 1996, p. 203
M 6.8.14	% of high priority targets successfully attacked			UNTL, 1996, p. 203
M 6.8.15	% of total target list successfully engaged			UNTL, 1996, p. 205
M 6.8.16	# of targets found per total targets			MIL-STD-1776A, 1994, p. 54; GAO/PEMD-96-10, 1996, p. 4
M 6.8.17	# of fixed targets found per total targets			MIL-STD-1776A, 1994, p. 54
M 6.8.18	# of relocatable targets found per total targets			MIL-STD-1776A, 1994, p. 54
M 6.8.19	# of targets killed per total targets			MIL-STD-1776A, 1994, p. 54; GAO/PEMD-96-10, 1996, p. 4
M 6.8.20	# of targets killed per total targets via missile, bomb, & gun success			MIL-STD-1776A, 1994, p. 54

Number	MOP/MOE	Definition (if needed)	Criteria (if needed)	Reference
M 6.8.21	<b>Shots per engagement</b>	Focuses on the part of engagement leading to weapons employment. Measures the potential to destroy the enemy based on one's ability to take shots.		Ford, 1994, p. 37
M 6.8.22	<b>Kills per engagement</b>	Measure of how many enemy aircraft are killed each time an engagement with one or more occurs.		Ford, 1994, p. 31
M 6.8.23	<b># of kills per sortie</b>			ASC/XRG, 1996, p.4-92; Eisenhardt, Eisenhardt, & Douthat, 1985; JAST, 1995
M 6.8.24	<b>Kills per missile fired</b>	Measure of how many enemy aircraft are destroyed every time an attempt is made to do so.		Ford, 1994, p. 39; Lehman & Jenkins, 1990, pp. 2-8
M 6.8.25	<b>Kills per gun firing attempt</b>	This measure would apply to kills scored from guns.		Lehman & Jenkins, 1990, pp. 2-8
M 6.8.26	<b>% of shots valid at launch</b>	A measure of aircrew entry into & recognition of valid launch parameters. A measure of the human element of air-to-air combat.		Ford, 1994, pp. 37-38
M 6.8.27	<b>Bomb-to-target ratio</b>			Johnson, 1996; Lehman Peio, Masters, & Bloomfield, 1989, p. 17; MIL-STD-1776A, 1994, p. 54
M 6.8.28	<b>Circular error probability (CEP)</b>	Applicable for air-to-ground scenarios in which the systems under evaluation affect either aimpoint or weapons accuracy.		Lehman & Jenkins, 1990, pp. 2-8
M 6.8.29	<b>Weapon miss distance</b>	This measure is the CEP counterpart for air-to-air scenarios. Its utility is dependent on the relationship between pilot input & simulated weapon performance.		Lehman & Jenkins, 1990, p. 2-8; Lehman et al., 1989, p. 33
M 6.8.30	<b>First shot opportunity</b>	This measures the performance up to the point at which one fighter, on either side, first enters the weapons envelope. This is the first possible time when a missile or gun can be fired within the parameters that "should" result in a hit on the target.		Ford, 1994, p. 34
M 6.8.31	<b>Probability of a hit (Ph)</b>			UNTL, 1996, p. 204
M 6.8.32	<b>Probability of kill (Pk)</b>			MIL-STD-1776A, 1994, p. 54; Lehman, et al., 1989, p. 33; UNTL, 1996, p. 204
M 6.8.33	<b># of enemy targets destroyed</b>			Eisenhardt et al., 1985; UNTL, 1996, p. 192
M 6.8.34	<b>% of engagements time offensive/defensive</b>	Measures the % of engagement time spent either offensive or defensive. Produces a direct comparison of air-to-air combat effectiveness.		Ford, 1994, p. 35
M 6.8.35	<b>% of engagements survived</b>	Concerned with the defensive aspects of air-to-air combat. Used to compare survival rates for different units using the same type of engagement start parameters.		Ford, 1994, p. 32
M 6.8.36	<b>% of assigned targets destroyed</b>			UNTL, 1996, p. 192

Number	MOP/MOE	Definition (if needed)	Criteria (if needed)	Reference
M 6.8.37	% of targets destroyed by first assigned friendly mission			UJTL, 1996, p. 4-73
M 6.8.38	% of target restruct unnecessarily			UJTL, 1996, p. 4-73
M 6.8.39	% of reattacked targets destroyed by reattacking mission			UJTL, 1996, p. 4-73
M 6.8.40	% of target sets assigned to inappropriate strike assets			UJTL, 1996, p. 4-73
M 6.8.41	% of Cruise missiles reaching target			UNTL, 1996, p. 192
M 6.8.42	% of friendly missiles, rockets, etc., successfully that engage targets			UNTL, 1996, p. 203
M 6.8.43	<b>Bomb Damage Assessment (BDA)*Cross reference to Air Combat measures</b>	Ability to determine the extent of bomb damage to target.		Evans, 1996; UJTL, 1996, p. 4-73; UNTL, 1996, p. 201
M 6.8.44	% of targets correctly assessed as destroyed, neutralized, or suppressed.			HQ USAF/XOOT, 1997
M 6.8.45	% of targets, restruct unnecessarily.			HQ USAF/XOOT, 1997
M 6.8.46	# of hours to access & evaluate target imagery or signals			UNTL, 1996, p. 201
M 6.8.47	# of minutes to assess & evaluate target imagery or signals			UNTL, 1996, p. 201
M 6.8.48	# of hours to prepare & disseminate BDA reports			UNTL, 1996, p. 201
M 6.8.49	# of hours to update targeting based on BDA reports			UNTL, 1996, p. 201
M 6.8.50	# of minutes to provide BDA voice report			UNTL, 1996, p. 201
M 6.8.51	# of Red kills per Blue platform (% of enemy forces destroyed)			MIL-STD-1776A, 1994, p. 54; Eisenhardt, et al., 1985; JAST, 1995; Lehman & Jenkins, 1990, pp. 2-8; UNTL, 1996, p. 204
M 6.8.52	% of enemy forces delayed or disrupted			UNTL, 1996, p. 204
M 6.8.53	% of enemy forces degraded			UNTL, 1996, p. 204
M 6.8.54	# of enemy surrender each day			UNTL, 1996, p. 204
M 6.8.55	Cost per kill			MIL-STD-1776A, 1994, p. 54
M 6.8.56	Red losses over time	# of Red targets/aircraft (hostile aircraft) destroyed in a specific time period.		JAST, 1995
M 6.8.57	# of neutral aircraft killed			Eisenhardt et al., 1985
M 6.8.58	Fratricide rate	Rate of 'friendly fire' deaths.		Bornman, 1993, p. 3-9; Ford, 1994, pp. 42-43; Lehman et al., 1989, p. 18; UNTL, 1996, p. 205
M 6.8.59	% attrition of own force			UNTL, 1996, p. 204
M 6.8.60	# of casualties by friendly fires			UJTL, 1996, p. 4-75
M 6.8.61	# of casualties among enemy civilians			UJTL, 1996, p. 4-73
M 6.8.62	# of aircrew returning to home base			UNTL, 1996, p. 192

Number	MOP/MOE	Definition (if needed)	Criteria (if needed)	Reference
M 6.8.63	% of collateral damage under proposed targeting policy is to nonmilitary targets.			UJTL, 1996, p. 4-22; UNTL, 1996, p. 205
M 6.8.64	# of sorties necessary to perform mission			Rau & Egbert, 1972
M 6.8.65	% of missiles, rockets, & other long-range attack systems successfully engaged targets			UJTL, 1996, p. 4-136
M 6.8.66	Tonnage of munitions used	How many tons of bombs were used.		GAO/PEMD-96-10, 1996, p. 4
<b>7</b>	<b>OTHER FLIGHT PERFORMANCE MEASURES (No comparable AFT)</b>			
<b>7.1</b>	<b>Detectability (No comparable AFT)</b>			
M 7.1.1	Detectability	Degree to which aircraft system is detectable during penetration, mission, or exit.		ACC/DRS, 1995a
M 7.1.2	Beyond Line of Site (BLOS) communications capabilities <i>*Cross reference to Air Combat measures.</i>	BLOS communications are needed for long-range control of air defense forces in the detection of an attack.		ACC/DRC, 1995a, p. 12; 1995b, p. 17
M 7.1.3	Threat detection <i>*Cross reference to Air Combat measures.</i>	Degree to which aircraft system can detect hostile air and ground threats.		ACC/DRS, 1995a, p. 33
M 7.1.4	Air-to-air missile engagements	Number of times threatened by Air-to-Air Missile.		ASC/XRG, 1996, p.4-92
M 7.1.5	Surface-to-air missile (SAM) engagements	Number of times threatened by SAMs.		ASC/XRG, 1996, p.4-92; ACC/DRS, 1995a, p. 34; MIL-STD-1776A, 1994, p. 54
M 7.1.6	Anti-air artillery (AAA) engagements	Number of times threatened (engaged) by AAA.		MIL-STD-1776A, 1994, p. 54
M 7.1.7	Light weapons fire engagements	Number of times threatened by light weapons fire.		ACC/DRS, 1995a, p. 34
M 7.1.8	Nuclear, Biological, & Chemical (NBC) threat detection <i>*Cross reference to Air Combat measures</i>	Ability to detect the presence of NBC contaminants.		ACC/DRS, 1995a, p. 37
M 7.1.9	Ability to penetrate hostile threat envelope	This ability allows combat delivery aircraft a measure of survivability while engaged by hostile threats.		ACC/DRS, 1995a, p. 33
M 7.1.10	Radio frequency (RF) guided missile engagements & countermeasures	Ability to detect the presence of radio frequency guided missile.		ACC/DRS, 1995a, p. 34; ASC/XRG, 1996, p. 4-78
M 7.1.11	Infrared/electro-Optical (IR/EO) threat detection, warning, & countermeasures	Ability to detect the presence of & provide countermeasures against IR missile threats.		ASC/XRG, 1996, p. 4-81
M 7.1.12	Laser threat detection, warning, & countermeasures	Ability to detect the presence of & provide countermeasures against any laser illumination (rangefinders, beamriders, designators, or weapons).		ASC/XRG, 1996, p. 4-83
M 7.1.13	Countermeasures selection efficiency			MIL-STD-1776A, 1994, p. 54
M 7.1.14	Ability to positively identify friendlies & hostiles <i>*Cross reference to Air Combat measures.</i>			ACC/DRC, 1995b, p. 19
M 7.1.15	# of attacks on Blue over time <i>*Cross reference to Interdiction Analysis</i>			JAST, 1995

Number	MOP/MOE	Definition (if needed)	Criteria (if needed)	Reference
<b>7.2</b>	<b>Survivability (No comparable AFT)</b>			
M 7.2.1	<b>Survivability</b>	Ability of mission-critical systems to survive (to avoid &/or withstand) the threat levels anticipated in their operating environment.		ACC/DRS, 1995b, p. 18; ASC/XRR, 1996; Ball, 1985; DoD, 1996b, p. 9; MIL-STD-1776A, 1994, p.54; UNTL, 1996, p.242
M 7.2.2	<b>Minutes to scramble fighters</b>			HQ USAF/XOOT, 1997
M 7.2.3	<b>% disruption of friendly centers of gravity</b>			HQ USAF/XOOT, 1997
<b>7.3</b>	<b>Vulnerability (No comparable AFT)</b>			
M 7.3.1	<b>Vulnerability</b>	Inability of an aircraft to withstand damage caused by a hostile environment is referred to as vulnerability of the aircraft to damage mechanisms.		Ball, 1985; MIL-STD-1776A, 1994, p. 54
M 7.3.2	<b>Probability to penetrate (PTP).</b>	PTP is made up of 3 factors: Penetration Altitude Factor (PAF), Threat Avoidance Factor (THAF), & Bomber Defense Factor (BDF). Sortie PTP is determined by multiplying the 3 factors. Determine each factor by an Inflight Performance Factor (IPF) when the desired activity is adequately evaluated. The IPF measures combined crew performance & equipment status. Additionally, for BDF, when activity cannot be evaluated inflight, use an Equipment Performance Factor (EPF) instead of IPF. When EPFs are used, include equipment that is inoperative prior to takeoff or landing, at the time of an air abort, or at a time which prevents applicable activity from being accomplished.		AFI 90-201/ACC SUP 1 (ACC/IGIX, 1996)
M 7.3.3	<b>Blue losses to SAMs</b>	<i>self explanatory</i>		JAST, 1995
M 7.3.4	<b>Blue losses to AAA</b>	<i>self explanatory</i>		JAST, 1995
M 7.3.5	<b>Susceptibility</b>	The probability that the aircraft is hit by a damage-causing mechanism, & is referred to as the susceptibility of the aircraft. Susceptibility can be divided into three general categories: (1)threat activity; (2) aircraft detection, identification, & tracking; & (3) missile launch or gun firing, propagator flyout, & warhead impact or detonation.		Ball, 1985; MIL-STD-1776A, 1994, p. 54
M 7.3.6	<b>% disruption of friendly centers of gravity</b>			HQ USAF/XOOT, 1997

Number	MOP/MOE	Definition (if needed)	Criteria (if needed)	Reference
<b>8</b>	<b>OTHER HUMAN PERFORMANCE MEASURES (No comparable AFT)</b>			
<b>8.1</b>	<b>Situation awareness (No comparable AFT)</b>			
M 8.1.1	<b>Situation awareness (SA) measures</b>	A pilot's continuous perception of self and aircraft in relation to the dynamic environment of flight, threats, & mission, & the capability to forecast, then execute tasks based on the perception.		ACC/DRC, 1995b, p. 28; ACC/DRS, 1995b, p. 19; ASC/XRR, 1996; MIL-STD-1776A, 1994, p. 54; Eisenhardt et al., 1985; JAST, 1995; Gayman, Schopper, Wourms, & Moroney, 1995; Rehmann, 1995, p. 15; Vidulich, 1994, p. 17; Vidulich, Dominguez, Vogel, & McMillian, 1994
M 8.1.2	<b>Cognitive issues</b>	Refers to the more central information processing issues associated with SA. These seem likely to be more important than the peripheral processes.		Adams, et al., 1991; Vidulich, 1994, p. 17; Vidulich, Dominguez, Vogel, & McMillian, 1994
M 8.1.3	<b>Perceptual-motor issues</b>	Peripheral psychological processes used to get information into or out of the human operator. Includes Sensory Acuity, Perception & Pattern Recognition, & Motor Control		Vidulich, 1994, p. 18; Vidulich, Dominguez, Vogel, & McMillian, 1994
M 8.1.4	<b>Sensory acuity</b>	Capabilities of sense modalities. Most obvious sense modality to consider is vision.		Vidulich, 1994, p. 18; Vidulich, Dominguez, Vogel, & McMillian, 1994
M 8.1.5	<b>Perception &amp; pattern recognition</b>	Processing that is involved with the preliminary assignment of stimulus meaning ("sizing up" the situation).		Vidulich, 1994, p. 20; Vidulich, Dominguez, Vogel, & McMillian, 1994
M 8.1.6	<b>Motor control</b>	Movement and coordination abilities		Vidulich, 1994, p. 20; Vidulich, Dominguez, Vogel, & McMillian, 1994
M 8.1.7	<b>Personality</b>	Personality factors (e.g., self-discipline, good attentiveness) influence the quality of an individual's SA.		Vogel, 1994, p. 33; Vidulich, Dominguez, Vogel, & McMillian, 1994
M 8.1.8	<b>Mental/physical factors</b>	Factors such as fatigue, stress, drugs, & alcohol.		Vogel, 1994, p. 33; Vidulich, Dominguez, Vogel, & McMillian, 1994
M 8.1.9	<b>Situational awareness global assessment technique (SAGAT)</b>	The most well-known objective metric of SA. SAGAT provides unbiased measures of SA across all of the operators' SA requirements that can be computed in terms of errors or percent correct and can be treated.		Gayman et al., 1995; Rehmann, 1995, p. 33; Vidulich et al., 1994
M 8.1.10	<b>Situational awareness rating technique (SART)</b>	SART is a subjective metric of SA.		Gayman et al., 1995; Rehmann, 1995, A-34; Vidulich et al., 1994
M 8.1.11	<b>Signal detection theory (SDT) measures</b>	SDT is an implicit metric (derived from task performance) of SA.		Rehmann, 1995, p. 15; Turner, 1995
M 8.1.12	<b>Crew situational awareness</b>	Method of measuring SA of air transport crews.		Rehmann, 1995, p. A-32
<b>8.2</b>	<b>Cognitive workload (No comparable AFT)</b>			
M 8.2.1	<b>Cognitive issues</b>	Refers to the more central information processing issues associated with SA. These seem likely to be more important than the peripheral processes.		Adams, et al., 1991; Vidulich, 1994, p. 17; Vidulich, Dominguez, Vogel, & McMillian, 1994
M 8.2.2	<b>Cognitive workload measures</b>	Instantaneous sum total of motor & cognitive demands on an operator (crew member) in performance of assigned duties.		AFOTEC/XRC, 1991, p. II-5; Lehman et al., 1989, p. 39; McMillan et al, 1991; MIL-STD-1776A, 1994, p. 54

Number	MOP/MOE	Definition (if needed)	Criteria (if needed)	Reference
M 8.2.3	<b>Human performance measures</b>	Measure of how the human performs under various conditions.		Rehmann, 1995, p. 3
M 8.2.4	<b>Physiological measures</b>	Changes in the body (i.e., increased heart rate, perspiration, nervous shakes, black-outs)		MIL-STD-1776A, 1994, p. 54; Rehmann, 1995, p. 12
M 8.2.5	<b>Eye-related physiological measures</b>	Changes in the eye and visual system caused by workload.		Rehmann, 1995, p. 12
M 8.2.6	<b>Blink duration</b>	Length (in time) of blinks		Rehmann, 1995, p. 12
M 8.2.7	<b>Blink latency</b>	Time between blinks.		Rehmann, 1995, p. 12
M 8.2.8	<b>Blink rate</b>	# of blinks per given time.		Rehmann, 1995, p. 12
M 8.2.9	<b>Eye movement analysis</b>			Rehmann, 1995, p. 12
M 8.2.10	<b>Pupil Diameter</b>			Rehmann, 1995, p. 12
M 8.2.11	<b>Heart-related physiological measure</b>	Changes in the cardio-vascular system caused by workload.		Rehmann, 1995, p. 12
M 8.2.12	<b>Heart rate</b>			Rehmann, 1995, p. 12
M 8.2.13	<b>Heart rate variability (HRV)</b>	Changes/abnormalities in the heart rate		Rehmann, 1995, p. 12
M 8.2.14	<b>Electrocardiogram (EKG/ECG) activity</b>	Measures changes (electrical) in the heart rate.		Rehmann, 1995, p. 12
M 8.2.15	<b>Brain-related physiological measures</b>	Changes in the brain/neural system caused by workload.		Rehmann, 1995, p. 12
M 8.2.16	<b>Electroencephalograph (EEG) activity</b>	Measures changes (electrical) in the brain.		Rehmann, 1995, p. 12
M 8.2.17	<b>Regional cerebral blood flow (rCBF)</b>	Detects blood flow in particular areas of the cerebral cortex (determines effect of workload on brain area activity).		Rehmann, 1995, p. 12
M 8.2.18	<b>Positron emission tomography (PET)</b>	Detects energy changes in the brain.		Rehmann, 1995, p. 12
M 8.2.19	<b>Misc. common physiological measures</b>			Rehmann, 1995, p. 12
M 8.2.20	<b>Blood pressure</b>			Rehmann, 1995, p. 12
M 8.2.21	<b>Blood volume</b>			Rehmann, 1995, p. 12
M 8.2.22	<b>Body fluid analysis</b>			Rehmann, 1995, p. 12
M 8.2.23	<b>Electrodermal activity (EDA)</b>	Detects electricity/electrical activity of the skin.		Rehmann, 1995, p. 12
M 8.2.24	<b>Electromyographic activity (EMG)</b>	Detects electricity/electrical activity of the muscular system.		Rehmann, 1995, p. 12
M 8.2.25	<b>Galvanic skin response</b>	Detects electricity/electrical responses from the skin.		Rehmann, 1995, p. 12
M 8.2.26	<b>Respiration</b>			Rehmann, 1995, p. 12
M 8.2.27	<b>Speech quality</b>			Rehmann, 1995, p. 12
M 8.2.28	<b>Muscle potential</b>	Detects reactions of muscle ability to workload conditions.		Rehmann, 1995, p. 12
M 8.2.29	<b>Subjective workload metrics (e.g., SWAT, NASA-TLX, MCH)</b>	Personal judgment of human participant.		MIL-STD-1776A, 1994, p. 54; Lehman et al., 1989, p. 39; Rehmann, 1995, p. 6
M 8.2.30	<b>Function allocation analysis</b>	Systematically allocating functions to man or machine. Determines tasks that will be performed by the human operators and maintainers of the system.		McMillan, Beevis, Stein, Strub, Salas, Sutton, & Reynolds, 1991, p. 15.

Number	MOP/MOE	Definition (if needed)	Criteria (if needed)	Reference
M 8.2.31	<b>Strategic workload</b>	A broader approach to the study of multiple task performance. 'People actively manage their time, energy, & available resources to accomplish tasks on time & with adequate performance &, at the same time, to maintain a comfortable level of workload. To do so, they dynamically modulate their priorities, strategies, focus of attention and effort.'		Adams, Tenney, & Pew, 1991, p. 8
<b>8.3</b>	<b>Other (No comparable AFT)</b>			
M 8.3.1	<b>Vigilance</b>	The ability to maintain a constant focus of attention.		Rehmann, 1995, p. 15
M 8.3.2	<b>Task/timeline analysis</b>			MIL-STD-1776A, 1994, p. 54
M 8.3.3	<b>Speed/accuracy Data</b>			MIL-STD-1776A, 1994; JAST, 1995
M 8.3.4	<b>Switch/control activation data</b>			MIL-STD-1776A, 1994, p. 54
M 8.3.5	<b>Subsidiary task performance</b>			MIL-STD-1776A, 1994, p. 54
M 8.3.6	<b>Inflight retargeting capability</b>		Inflight retargeting capability, aircrew "alert times" on threat, spherical "coverage" % (JAST, 1995)	JAST, 1995
M 8.3.7	<b>% of flying accidents attributed to human error (last 12 months)</b>	<i>self explanatory</i>		HQ USAF/XOOT, 1997

## ATTACHMENT 1, Air Combat Command FY96 Mission Area Plans (ACC MAPs) Recap Sheets

### Air Combat Command FY96 Mission Area Plans (ACC MAPs) - Recap Sheets<sup>8</sup>

(**From:** ACC/DR. (1996). *Mission Area Plans*. [Online]. Available: <http://nt2.dr.langley.af.mil/map01.html>)

- 1) Air Superiority
  - Counter Air<sup>9</sup>
  - Theater Missile Defense (TMD)
  - Strategic Air Defense<sup>10</sup>
- 2) Precision Employment
  - Strategic Attack/Interdiction
  - Close Air Support (CAS)
- 3) Readiness & Sustainment
  - Contingency Base Operations
  - Rescue
- 4) Information Dominance
  - Theater Battle Management (TBM)
  - Electronic Warfare (EW)
  - Surveillance & Reconnaissance
  - Counter Information
- 5) Global Mobility
  - Combat Delivery

*For General Information on MAPs Contact HQ ACC MAP Analysis Support Team (MAST) at:*

Phone: (757) 764-7255 or 7261

DSN: 574-7255, or 7261

FAX: extension 7217

E-Mail: [sullivat@hqaccdr.langley.af.mil](mailto:sullivat@hqaccdr.langley.af.mil)

Mail:

HQ ACC/DR-XP MAST

204 Dodd Blvd., Suite 204

Langley AFB, VA 23665-2777

---

<sup>8</sup> This attachment contains the *summaries* of all the ACC's FY96 MAPs.

<sup>9</sup> This MAP is classified (SECRET) and was not available for review. The Recap Sheet is unclassified and appears in this attachment.

<sup>10</sup> This MAP is unclassified and was available for review. The Recap Sheet is also unclassified and appears in this attachment. The unclassified MAPs are available on the Internet at the above address.

# **Air Superiority**



## Counter Air MAP

### FY96 Recap Sheet

---

#### **Mission Area Assumptions:**

- National military strategy dictates a forward presence of forces in strategic positions around the world
- Theater component commanders employ air-to-air fighters to attain regional air superiority
- Counter-air force structure is composed of fighter aircraft and their associated armament (air-to-air missiles and guns) and necessary support assets to accomplish these tasks

#### **Counter Air Operational Objectives:**

- Gain and maintain control of the air
- Maintain constant readiness
- Deploy as directed
- Employ as directed
- Maintain continued sustainability

#### **Counter Air Operational Tasks:**

- Destroy or neutralize enemy fighters, bombers and cruise missiles
  - Detect/ID airborne enemy threats (fighters, bombers and cruise missiles) in presence of countermeasures
  - Target/Attack (Employ fire control systems) airborne enemy threats in presence of countermeasures
  - Ensure weapons destroy/neutralize airborne enemy threats in presence of countermeasures
  - Survive

#### **Key Deficiencies:**

- Logistics supportability deficiencies
  - Poor Reliability (Low Mean time between failure (MTBF)) and Maintainability
  - Significant airlift support required for deployment
  - Lack of standardization across weapon system and subsystems
- F-15C limitations (lack of secure data link) degrade its combat capability
- AMRAAM is losing its advantage against improving threat
- AIM-9 is at significant disadvantage within visual range
- Air combat training system assets necessary to maximize pilot familiarity and proficiency with aircraft systems and weapons have several deficiencies
- Realistic threat environment not produced in Blue/Gray air defense systems
- Participants in RED/GREEN FLAG exercises is diminished
- Little or no flexibility in scenario development

**Key Solution Concepts:**

- F-22 will incorporate numerous improvements to correct deficiencies
- Major F-15 Avionics improvements needed to retain viability until F-22
  - Combat ID technologies
  - APG-63RMU radar needed to correct supportability problems in current radar
  - Improved Head-up Display (HUD) required to correct poor reliability and parts obsolescence
  - Tactical Electronic Warfare Suite (TEWS) upgrades will provide better detection of threat aircraft
  - Joint Tactical Information Distribution System (JTIDS) Class IIR (Now MIDS?) terminals will provide a significant increase in Situational Awareness (SA)
- Internal Countermeasures Suite (ICS) Band 3 needed to counter modern threats
- Helmet Mounted Cueing System (HMCS) needed to take advantage of improved weapons
  - Global Positioning System (GPS) will aid in navigation and SA
- Supportability upgrades planned to reduce aircraft turn times and increase number of sorties
- Major avionics improvements required to improve F-16's air-to-air capability
- Combined Interrogator Transponder (CIT)
- ALR-56M Radar Warning Receiver (RWR) will improve detection of potential threats
- Multi-Mission Computer (MMC) (Block 50) provides additional throughput and increases reliability
- Operational Flight Profile (OFP) updates to optimize avionics software
- Weapon Modernizations
- AIM-9X
- AMRAAM Preplanned Product Improvement
- PGU-28 (20mm ammunition)
- Air Combat Training Systems Modernizations
- Air Force Mission Support System (AFMSS)

**Bottom Line Impact:**

- Planned aircraft and weapons improvements will correct many existing deficiencies, but we must continue to push technology to ensure counter-air weapon systems are able to gain and maintain control of the air in any contingency operation (See mission area post investment assessment in the MAP.)



## Theater Missile Defense (TMD) MAP

### FY96 Recap Sheet

---

#### **Mission Area Assumptions:**

- Theater Ballistic Missiles will continue to proliferate
- Air Force emphasis on Attack Operations and Boost Phase Intercept: Kill TELs and Theater Missiles (both Cruise and Ballistic Missiles) early in their life-cycle
- Maintain focus on Centralized Control and Decentralized Execution throughout the Joint Theater Battle Management architecture

#### **TMD Operational Objectives:**

- Destroy Theater Missiles (TM) and their infrastructure as far forward as possible (Attack Operations)
- Destroy TMs inflight (Active Defense)
- Minimize TMs effectiveness and damage (Passive Defense)
- Provide Command and Control in support of TMD operations

#### **TMD Operational Tasks:**

- Destroy TMs/TELS on the ground
- Destroy Cruise and Ballistic Missiles inflight
- Provide Real Time Command and Control

#### **Key Deficiencies:**

- Capability to track and destroy TMs during all phases of threat's life cycle
  - Improved on- and off-board sensors
  - Standoff weapons for Boost Phase Intercept
- Time sensitive (Command, Control, Communications, Computers, Intelligence (C4I) system responsive to TMD timelines
- Intelligence Preparation of the Battlefield for Rest of World
- Boost Phase Intercept Kill Mechanism

#### **Key Solution Concepts:**

- Automatic Target Recognition modifications to surveillance and attack platforms
- Airborne Laser for boost phase intercept
- Real-time computer based decision aids & C4I connectivity to meet TMD timelines
- Develop Intelligence Preparation of the Battlefield (IPB) methodology
  - Validate regional threat database

#### **Bottom Line Impact:**

- Weapons of mass destruction will continue to proliferate
- Air Force must pursue technologies that increase US capability to destroy TMs as early as possible in their life cycle
- Failure to acquire Boost Phase Intercept (BPI) weapon system will place undue stress on Army and Navy terminal defenses due to the possibility of threat weapon fractionation



## Strategic Air Defense MAP

### FY96 Recap Sheet

---

#### **Mission Area Assumptions:**

- Maintain the capability to respond to all threats against North American airspace
- The threat will remain significant as we move into the future

#### **Strategic Air Defense Operational Objectives:**

- Defeat the enemy in the air
- Establish and Maintain battle management

#### **Strategic Air Defense Operational Tasks:**

- Destroy/damage/neutralize air vehicles in flight
- Detect/identify/monitor situation
- Control airborne missions
- Assess theater operations
- Provide command and control networks
- Provide TW/AA of ballistic missile and air attack
- Preposition equipment and supplies
- Plan and adjust theater air plan
- Provide intelligence
- Train mission ready personnel
- Respond and prepare for execution

#### **Key Deficiencies:**

- Detection of low-altitude, low-observable threats
- High confidence identification of long-range, wide-area threats
- Beyond line of sight (BLOS) communications
- Capability to rapidly process sensor and intelligence information and display threats of interest to the decision-maker

#### **Key Solution Concepts:**

- Federal Aviation Administration (FAA)/Air Force Radar Replacement to provide better low-level detection and coverage
- Automated Air Movement Data Systems for exchange of flight plans, increasing confidence and speed of target identification
- Region/Sector Operations Control Center (R/SOCC) modernization will enable processing and display of additional sensor information and track data
- Wide-Area Surveillance System to enable detection of small, low-observable targets at a range of 1500 NM from North American airspace
- Iceland Air Defense System (IADS) provides interim capability in Iceland until the R/SOCC modernization system is fielded

- AN/FPS-124 Short Range Radar provides low observable capability in the North Warning System covering northern approaches to North America

### **Critical Enabling Technologies:**

- Over-the-Horizon sensors
- Bistatic sensors
- Space-time adaptive processing
- Adaptive Sidelobe Nulling/Processing
- Improved sensor resolution
- Indirect hostile target identification
- Real-time signal processing
- 3-D Large screen displays
- Extremely high-capacity/high speed memory
- Distributed software processing
- Multi-spectral observables fusion
- Near real time target classification
- Intelligence data correlation
- Sensor data fusion
- Multi-level Secure Distributed processing
- High speed communications
- Automatic Communications Link Setup Control
- Electronic key management

### **Bottom Line Impact:**

- Sensors have and are being modernized, but processing has not been upgraded to match capability and coverage of new sensors
- While sensors have been modernized, their detection capabilities have not kept pace with technology and potential threats
- New, improved, or additional sensors cannot be brought on-line unless the capability to process information is improved
- Must take action now to improve information processing capability

## **Precision Employment**



## Strategic Attack/Interdiction MAP

### FY96 Recap Sheet

---

#### Mission Area Assumptions:

- Support of two Major Regional Conflicts (MRC) strategy.
- Home based forces with limited overseas presence.
- Extensive range and payload required for many theaters.
- Increased use of precision standoff adverse weather weapons.
- Increased and more sophisticated threats.
- Force structure that is fiscally constrained and is limited at a twenty fighter wing equivalent.

#### SAI Operational Objectives:

- Reduce enemy sortie generation.
- Counter enemy air defenses.
- Counter use of weapons of mass destruction.
- Destroy/damage enemy military infrastructure.
- Interdict enemy forces and combat support.
- Interdict naval forces.
- Disrupt enemy political base.
- Destroy/damage economic support base.

#### SAI Operational Tasks (top 10 of 28 total):

- Deny use of runways and taxiways.
- Destroy/damage/suppress mobile SAMs/TELs/AAA/directed energy weapons.
- Destroy/damage ballistic missiles/launchers/TELs on the ground.
- Provide self protection.
- Destroy/damage/delay advancing combat forces.
- Destroy/disable fixed forces.
- Support sortie production.
- Destroy/damage/suppress fixed SAMs/TELs/AAA/directed energy weapons.
- Destroy/damage/suppress national C4I.
- Destroy/neutralize/deny access to WMD storage and production.

#### Key Deficiencies:

- Adverse weather accurate/precise weapon delivery capability.
- Situational awareness.
- Stand-off weapon delivery capability.
- Threat detection/avoidance/countermeasures.
- Targeting/Navigation.
- C<sup>4</sup>I
- Reliability, Maintainability, and Supportability (RM&S).

**Key Solution Concepts:**

- B-2, Joint Strike Fighter.
- Modifications.
  - B-1 -- Conventional Munitions Upgrade Program, real-time information in the cockpit (Link 16), avionics computer upgrades.
  - B-52 -- Demand Assigned Multiple Access upgrades, advanced weapons integration .
  - F-15E -- Multipurpose Display Processor upgrade, LINK 16, Band 1.5, APG-70 replacement
  - F-16 -- Falcon-up, missile warning system, LANTIRN replacement, internal targeting system, Global Positioning System, Modular Mission Computer.
  - F-117 -- Mid-life improvements, advanced weapons integration, video tracker.
- Joint Air-to-Surface Standoff Missile (JASSM), Joint Stand Off Weapon (JSOW), Joint Direct Attack Munitions (JDAM), Sensor Fuzed Weapon (SFW),
- Wind Corrected Munition Dispenser, and improved hard and deeply buried target kill capability.

**Bottom Line Impact:**

- Modernization and technology must contribute directly to solving mission area deficiencies, provide a significant increase to the Combat Air Forces' combat capability, and must be affordable. As new systems are being developed and fielded, efforts to reduce the cost of weapon system ownership/operation must continually be addressed. Technological insertion ideally will cover a large spectrum of deficiencies identified in the mission area plans.
- Modernization of the current inventory and supporting technologies for future aircraft and/or weapon delivery platforms will allow the USAF to support the worldwide interest of the United States of America.



## Close Air Support (CAS) MAP

### FY96 Recap Sheet

---

#### **Mission Area Assumptions:**

- Support of two Major Regional Conflicts (MRC) strategy
- Day/night adverse weather capability required for all CAS platforms
- Multi-role aircraft will be used in CAS
- Interoperability with other military Services will be essential
- Force structure that is fiscally constrained and is limited at a twenty fighter wing equivalent

#### **CAS Operational Objectives:**

- Defeat enemy within close proximity to friendly forces

#### **CAS Operational Tasks:**

- Destroy/disable/neutralize engaged combat forces
- Conduct/coordinate airborne airstrike terminal control

#### **Key Deficiencies (66 total):**

- Situational awareness
- Range/Loiter
- Night/adverse weather capability
- Threat detection/avoidance/countermeasures
- Targeting/Navigation
- C<sup>4</sup>I
- Reliability, Maintainability, and Supportability (RM&S)

#### **Key Solution Concepts:**

- Joint Strike Fighter
- A-10 critical mods
  - Missile warning system
  - Embedded Global Positioning System (GPS)/Inertial Navigation System (EGI)
  - Situational Awareness Data Link (SADL)/Enhanced Position Location Reporting System (EPLRS)
  - Low Altitude Software and Targeting Enhancements (LASTE)
- F-16 CAS enhancements: Falcon-up, EGI
- Advanced Weapons Integration

#### **Bottom Line Impact:**

- Modernization and technology must contribute directly to solving mission area deficiencies, provide a significant increase to the Combat Air Forces' combat capability, and must be affordable. As new systems are being developed and fielded, efforts to reduce the cost of weapon system ownership/ operation must continually be addressed. Technological insertion ideally will cover a large spectrum of deficiencies identified in the mission area plans.
- Modernization of the current inventory and supporting technologies for future aircraft and/or weapon delivery platforms will allow the USAF to support the worldwide interest of the United States of America.

## **Readiness & Sustainment**



## Contingency Base Operations MAP

### FY96 Recap Sheet

---

#### **Mission Area Assumptions:**

- Continued need to provide airbases in forward locations
- Continued chemical/biological (chem/bio) threat
- Continued conventional attack threat
- Continued need to rapidly restore damaged air base assets
- Continued need to provide Contingency Operating capability in operations other than war

#### **Contingency Base Operations Operational Objectives:**

- Establish Contingency Operating Locations
- Sustain Contingency Operating Locations
- Protect Contingency Operating Locations

#### **Contingency Base Operations Operational Tasks:**

- Provide contingency operating locations
- Defend contingency operating locations
- Recover contingency operating locations

#### **Key Deficiencies:**

- Inadequate chemical/biological defense equipment
- Inadequate base equipment
- Limited ability to defend/defeat ground based threats
- Limited ability to transport and protect ground defense personnel
- Limited ability to provide field kitchen facilities
- Limited ability to provide field laundry facilities
- Limited ability to provide vaccines against chemical/biological agents
- Limited ability to mitigate environmental damage
- Data networks vulnerable to intrusion/exploitation
- Limited ability to provide public address systems

#### **Key Solution Concepts:**

- New family of deployable shelters
- New family of power generation/distribution systems
- Chemical/Biological warfare defense equipment
- Up-Armored (UA) Heavy Mobility Multipurpose Wheeled Vehicle (HMMWV)
- Tactical Automated Security System
- Initial Deployable Kitchen (IDK)
- Deployable laundry system
- Field incinerator
- Chemically hardened air transportable hospital
- Scope Shield II radios
- Deployable data communications system

**Key Technologies:**

- Wireless air base power/superconductivity
- Ultra-light deployable facilities
- Advanced laser systems for chem/bio detectors
- Advanced chemical protection systems
- Self-reporting facility damage assessment systems
- Advanced ballistics/fragmentation protection
- Advanced security technology
- Modular housekeeping equipment technology
- Advanced hazardous waste disposal technology
- Advanced data burst/programmable frequency communications technology

**Bottom Line Impact:**

- CBO Force Beddown infrastructure and equipment must be in place before sustained operations (aircraft generation) can take place. Failure to procure a new family of assets forces the continued use of inefficient and obsolete equipment and forfeits the capability to rapidly establish and sustain contingency locations.
- Commanders must have the ability to counter increasingly advanced chemical, biological, and conventional threats across the spectrum of conflict. Failure to provide this capability may prevent air power from influencing rapidly changing scenarios, especially early in a deployment.



## **Rescue MAP**

### **FY96 Recap Sheet**

---

#### **Mission Area Assumptions:**

- Maintain current operations tempo, current frequency of humanitarian support missions, and support two MRC taskings
- Execute all taskings during both peace and war, hostile or non-hostile environments, in visual or adverse weather conditions

#### **Combat Rescue Operational Objective:**

- Recover Downed aircrew

#### **Combat Rescue Operational Tasks:**

- Locate the downed crewmember (survivor)
- Communicate with the survivor and command & control assets to coordinate a recovery
- Recover the survivor by penetrating the threat, day or night and in adverse weather conditions

#### **Key Deficiencies:**

- Replacement aircraft
  - HH-60G
  - HC-130P/N
- Long-range Communications: Limited capability to communicate over the horizon
- Threat Avoidance: Combat Rescue aircraft are vulnerable to attack
- Maintainability: Basic aircraft affected by modifications to HH-60G Pave Hawk configuration; older systems expensive to maintain
- Modeling: Lack of adequate theater campaign model
- Training: Training devices and aircraft configuration dissimilarities

#### **Key Solution Concepts:**

- Night Adverse Weather Operations: Install Forward Looking Infrared (FLIR), infrared strobe lights, automated hover system, and obstacle avoidance system
- Long-range Communications: Install Satellite Communications (SATCOM) into integrated cockpit
- Threat Avoidance: Improved capability to detect/degrade/defeat threats. Install chaff/flare dispensers, missile warning system, and improved radar warning system
- Maintainability: Replace unsupportable/high-maintenance items, upgrade wiring in older aircraft, increase service life of critical components, and upgrade airframe structure
- Modeling: Useable theater model to help determine force structure and modifications
- Training: Increased funding for simulator mods to keep pace with aircraft mods
- Aging Aircraft: Replace aircraft to keep current force structure capability
  - Replacement aircraft
  - Vertical capable, long range, fast

**Key Technologies:**

- Intraformation Positioning System
- Integrated cockpit/avionics
- Sensor hardening
- Multi-spectral expendables
- Large aircraft Infrared Countermeasures (IRCM)
- Enhanced missile warning
- On-board laser IRCM
- Improved night vision systems
- Intraformation positioning system
- Integrated cockpit/avionics
- Tactical and mobility aircraft infrared countermeasures
- Enhanced missile warning
- On-board laser infrared countermeasures
- Sensor hardening
- Multi-spectral expendables
- Increase Speed, Range and Cabin size

**Bottom-Line Impact:**

- Lack of night adverse capability will reduce capability to recover survivors under these conditions
- Without long-range communications capability Combat Rescue forces cannot interface into the command and control network
- Lack of Survivability enhancements reduce capability of Combat Rescue to accomplish Major Regional Conflict (MRC) and Humanitarian/Peace-keeping taskings
- Combat Rescue force must pursue fleet modification/upgrade programs to lower cost of ownership and maintain current level of performance
- Modeling capability is essential to force structure determination and capability evaluation
- Simulators must be upgraded if they are to provide realistic training
- Lack of a replacement aircraft will result in inadequate force structure and higher cost of ownership

## **Information Dominance**



## Theater Battle Management (TBM) MAP

### FY96 Recap Sheet

---

#### **Mission Area Assumptions:**

- IAW DPG, maintain capability to support two, nearly simultaneous major regional conflicts
- Current capability and needs being redefined in the ongoing TBM Strategy-to-Task
- E-3, Airborne Battlefield Command and Control Center (ABCCC), and Joint Surveillance and Target Attack RADAR System (JSTARS) service life extensions possible
- Fielding of Modular Control Equipment (MCE) Preplanned Product Improvement (P<sup>3</sup>I), Theater Deployable Comm (TDC), Combat Intelligence System (CIS), and Air Force Mission Support System (AFMSS) will enable users to meet current needs
- Air National Guard contribution remains constant
- Long-range plans for TBM support interoperability with the Global Command and Control System (GCCS) common operating environment for C<sup>2</sup> and Joint and Service automated information systems

#### **Theater Battle Management Operational Objectives:**

- Establish/maintain effective battle management

#### **Theater Battle Management Operational Tasks:**

- Assess theater operations/Provide indications and warnings
- Plan/adjust theater operations plan
- Respond to taskings/Prepare for execution
- Control alert/airborne missions
- Provide/Protect C<sup>2</sup>I networks and systems
- Provide self protection for air vehicles
- Detect/identify/monitor theater situation/provide R&S
- Pack/configure/assemble (for movement) people/equipment/etc
- Replenish/resupply munitions, equipment, tools, spares, consumables, tech data, POL
- Collect/disseminate mapping data on area of operations
- Locate/communicate/recover downed aircrews/isolated personnel

#### **Key Deficiencies:**

- Combat planners lack automated tools for quickly developing and analyzing courses of action
- Lack automated correlation of existing command and control data feeds and communications connectivity for common battlefield picture and ATO (Air Tasking Order) dissemination inside and outside AOR
- Limited capability to create, distribute, and refine ATO changes or provide intelligence targeting updates
- Automated capability to process requests for information and imagery inadequate
- Automated access to combat information insufficient

**Key Solution Concepts:**

- Document Crisis Response (Integrate, develop planning tools); Provide combat planners with decision aids and expert systems
- Develop an integrated, enhanced battlefield situation display; Fuse intelligence threat display; Acquire lightweight, high capacity deployable communications
- Integrate data links to disseminate common picture of the battlefield and mission taskings (JTIDS, Tactical Information Broadcast System (TIBS), CS)
- Document near-real-time data to the cockpit requirements; develop automated decision support tools at the Air Operation Center (AOC)
- Acquire theater-level automated imagery request system, direct imagery, theater dedicated reconnaissance exploitation and correlation support to AOC
- Integrate data feeds to AFMSS and develop interfaces between wing-level systems
- Integrate logistic information/decision support systems into AOC systems

**Key Technologies (Enabling):**

- Sum of technologies needed to enable C<sup>4</sup>I for the Warrior concept; massively parallel processing, collaborative computing, rule-based information and interface management, open systems and multi-sensory MMI; supports push-pull data exchange, dynamic filtering
- Technologies, including phased array antennas, needed for situational awareness data and other C<sup>4</sup>I for the Warrior traffic to users while in motion
- Repository of message catalogs, control structures, protocols and waveforms to support two-way translation and mapping among both bit and character-oriented data systems; support software to quickly integrate other languages
- Automated management algorithms to select and set up global connections among several Satellite Communication (SATCOM) users; construction of multi-functional programmable radio interoperable with existing tactical radios; theater wide communications management using automated status polling, embedded rerouting, service maintenance algorithms, and knowledge-based prediction

**Bottom Line Impact:**

- Theater-wide common real-time understanding of current battlespace, with the ability to zoom and scan in time and space, exercise a priori trial force employments
- Provide users common battle picture regardless of activity (i.e., - move Control and Reporting Center (CRC) forward in theater for positioning of future bistatic platforms
- Communications interoperability among stovepipe systems is vital in joint and coalition warfare
- Improve reliability of high priority communications; improve deployability and supportability for tactical line-of-site communications; provide the most utility and reliability from the total of the available theater communications



## Electronic Warfare (EW) MAP

### FY96 Recap Sheet

---

#### Mission Area Assumptions:

- EW support is required for all combat scenarios
- Multi-role aircraft will be used for Manned Destructive Suppression of Enemy Air Defenses (SEAD)
- On-board self protection is necessary for end game countermeasures
- Joint Air Strike Technology (JAST) will provide Manned Destructive SEAD

#### Electronic Warfare Operational Objectives:

- Control the Electromagnetic Spectrum through the Electronic Attack, Protect, and Support tasks
- Increase ability of aerospace and surface forces to perform their mission

#### Electronic Warfare Operational Tasks:

- *ATTACK*
  - Reactively suppress surface-to-air threats
  - Preemptively destroy surface-to-air threats
- *PROTECT*
  - Deny acquisition
  - Detect and Warn
  - Counter the threat
- *SUPPORT*
  - Collect signals
  - Reprogram

#### Key Deficiencies:

- Limited ability to jam and destroy advanced threat systems
- Limited ability to locate and destroy mobile threat systems
- Limited ability to defend aircraft against advanced Infrared (IR)/Radio Frequency (RF) threats

#### Key Solution Concepts:

- *ATTACK*
  - Preemptive destruction: Concept exploration is in progress. Modification of existing hard ordnance. Development of targeting system
  - Reactive Suppression: Improvements to existing F-16 HARM Targeting System. Improvements to existing weapon (HARM). Follow-on weapon
  - Support Jamming: Follow-on joint system
- *PROTECT*
  - Provide IR Surface-to-Air Missile countermeasures for all combat aircraft
  - Upgrade situational awareness and jamming equipment against RF threats on combat aircraft
- *SUPPORT*
  - Provide electronic warfare integrated reprogramming as quickly as possible to the warfighter
  - Provide the best intelligence available to reprogram combat aircraft

**Bottom-Line Impact:**

- The defense guidance for operating effectively with a smaller force structure mandates an improved capability for protecting our combat assets. The Electronic Warfare Mission Area Assessment and Mission Needs Analysis shows that a combination of preemptive destruction of the threat, reactive suppression of the threat, and self protection from the threat provides the most cost-effective approach. The impact of not meeting these needs is higher combat asset attrition.



## Surveillance and Reconnaissance MAP

### FY96 Recap Sheet

---

#### Mission Area Assumptions:

- Complementary airborne and spaceborne reconnaissance assets
- Sensitive Reconnaissance Operations (SRO) simultaneous with Defense Planning Guidance (DPG) for two near simultaneous major regional conflicts

#### EO Imaging Satellite RC-135 (Rivet Joint)

#### Surveillance and Reconnaissance Operational Objectives:

- Sensitive Reconnaissance Operations
- Surveillance and Reconnaissance support to Theater Commanders

#### Surveillance and Reconnaissance Operational Tasks:

- Assess operations: Provide indications and warning
- Detect/Identify/Monitor Situation: Provide surveillance and reconnaissance
- Provide intelligence support directly to the warfighter
- Sustain efficient operations

#### Key Deficiencies:

- *There are seven key deficiency areas:*
  - Collection and Processing
  - Communications
  - Reliability, Maintainability, Sustainability
  - Survivability
  - Training
  - Human Factors
  - Security

*A full listing of mission area deficiencies is available from the Defense Technical Information Center (DTIC) by requesting document ESC-TR-95-117 (S/NF).*

#### Key Solution Concepts:

- Modernize existing systems:
  - Acquire additional RC-135 airframes and sensors
  - Advanced sensor upgrades to U-2 and RC-135 platforms
  - Data link upgrades
  - R,M,S upgrades to reduce O&S costs
  - Improved defensive capabilities
  - Joint Service Imagery Processing System upgrades
  - Contingency Airborne Reconnaissance System upgrades
- Acquire new airborne reconnaissance systems
  - First generation endurance UAVs (Darkstar, Global Hawk)

- U-X system as replacement for U-2
- Transatmospheric vehicle to replace SR-71
- Theater Airborne Reconnaissance System (TARS) to replace RF-4C
- Common Combat Support Aircraft for RC-135 missions
- Acquire new ground processing and exploitation systems
  - Distributive Common Ground Station
  - Common Imagery Ground Surface System
- Space system upgrades
  - Space Based Infrared System (SBIRS)
  - Space Based Radar System (SBR)
  - Various TENCAP initiatives

### **Top Ten Material Solutions:**

1. ASARS II Upgrade Program
2. Tier III- UAV with ground receipt, processing, exploitation and dissemination system
3. Tier II+ UAV with ground receipt, processing, exploitation and dissemination system
4. SYERS Upgrade Program
5. Tactical Space System (TACSAT)
6. MAE UAV Concept
7. Rivet Joints 15 & 16
8. Distributed Common Ground Station
9. ASARS II Processing Upgrades
10. SYERS Processing Upgrades

### **Bottom Line Impact:**

- The Surveillance and Reconnaissance MAP identifies a significant inability to support the DPG precept of two near simultaneous starting major regional conflicts with our existing force structure. There are simply too few airframes, sensors, and ground exploitation systems to support these taskings. This inability to support the warfighting commanders will be further exacerbated by National Command Authorities' requirements levied atop conflict tasking. Secondly, collection technology is progressing ahead of processing, exploitation, and dissemination technologies. This condition is leading to "stove-pipe" architectures with increased risk through reliance on a single node. Failure of the node leaves required data collected, but not exploited and disseminated, depriving the warfighting decision-makers of information they must have.



## Counter Information MAP

### FY96 Recap Sheet

---

#### **Mission Area Assumptions:**

- National military strategy recognizes our need for influencing policies and actions of others beyond U.S. borders. Deterrence is also identified as one of the primary U.S. military roles
- Theater component commanders employ Counterinformation methods to attain information dominance. Information dominance greatly simplifies achieving other campaign objectives in support of national objectives
- Counterinformation consists of Defensive and Offensive aspects to attain information dominance

#### **Counterinformation Operational Objectives:**

- Identify and defend against Information Warfare (IW) threats
- Maintain constant readiness
- Deploy as directed
- Employ as directed
- Maintain sustainability

#### **Counterinformation Tasks:**

- Establish, maintain and conduct protective security measures of friendly information systems and procedures
- Conduct psychological operations
- Conduct military deception operations
- Conduct Electronic Warfare operations
- Conduct physical destruction of selected enemy information systems

#### **Selected Deficiencies:**

- Limited capability to counter Electro-Magnetic (EM) interference
- Limited capability to protect networks from disruptions
- Limited capability for selected sensors to operate in challenged environments
- Limited hardware and software for network protection
- Limited camouflage, concealment and deception capabilities
- Limited modeling and simulation processes for network analysis
- Limited non-lethal alternatives for accomplishing mission objectives

#### **Selected Solution Concepts:**

- Increase selected embedded systems hardness against EM interference
- Base Network Control Centers (BNCC) will incorporate numerous improvements to correct network deficiencies
- IW Analysis Modeling and Simulation (AMS) will aid in determining optimum configurations for improved network protection
- Improved offboard information systems to increase onboard sensor effectiveness
- Selected non-lethal methods for accomplishing mission objectives with a minimum of collateral damage

**Bottom Line Impact:**

- Planned improvements will correct many existing deficiencies, but we must continue to push technology to ensure the Counterinformation mission achieves national and military objectives. See AF Counterinformation MAP FY1996 for more specific investment assessments and projections.

## **Global Mobility**



## Combat Delivery MAP

### FY96 Recap Sheet

---

#### **Mission Area Assumptions:**

- Maintain current operations tempo, current frequency of humanitarian support missions, and support two Major Regional Conflict (MRC) taskings
- Execute all taskings during both peace and war, hostile or non-hostile environments, in visual or adverse weather conditions

#### **Combat Delivery Operational Objectives:**

- Power Projection
- Force Sustainment

#### **Combat Delivery Operational Tasks:**

- Movement of equipment, supplies, and personnel, including aeromedical evacuation through airland operations
- Airdrop of equipment, supplies, & personnel to support theater forces

#### **Key Deficiencies:**

- Electrical systems
- Subsystem sustainability insufficient
- Power supplies too unstable for solid-state components
- Vulnerable to threats
- Training devices not concurrent with aircraft
- Flight management system near capacity for processing & memory
- Modeling
- Lack adequate theater campaign modeling capability
- Precision airdrop capability limited
- Replacement aircraft
- C-130Es begin to reach service life in 2002

#### **Key Solution Concepts:**

- Threat countermeasures & detection
  - Chaff/flare dispensers
  - Missile & radar warning systems
- Upgrade/replace less supportable subsystems
  - APN-59 radar
  - Station keeping equipment
- Upgrade electrical system
- C-130H3 aircrew training device, simulator mods
- Improved flight management system architecture
- Enhanced logistics for campaign level model
- GPS integration
  - C-130J & Advanced Theater Transport

**Key Technologies:**

- Enhanced missile warning system
- Onboard laser IR countermeasures
- Quiet Knight III
- Integrated cockpit avionics
- Subsystem integration technology
- Ballistic wind sensors
  - Improved airlift cargo handling

**Combat Delivery Configuration Plan**

- Provides C-130s with essential survivability enhancements and other improvements to reduce cost of ownership of fleet
  - Based on mission area strategy-to-task analysis and fiscal constraining analysis for maximizing combat capability & cost of ownership
- Establishes baseline for all C-130 modernization planning/programming out to FY2015
- Selections with current funding streams
  - Fleetwide defensive systems
  - Radar warning receivers
  - APN-59 radar replacement
  - NVIS lighting
  - Autopilot/GCAS

**Bottom Line Impact:**

- Lack of Survivability enhancements reduce capability of combat delivery to accomplish MRC and Humanitarian/Peace keeping taskings
- Combat delivery force must pursue fleet modification/upgrade programs to lower cost of ownership and maintain current level of performance
- Simulators must be upgraded if they are to provide realistic training
- Current/future operations require an all-altitude/all-weather first-pass precision airdrop capability to support MRC and humanitarian/peacekeeping
- Lack of a replacement aircraft will result in inadequate force structure and higher cost of ownership

## **ATTACHMENT 2, MAJCOM Operational Readiness Inspection Criteria**

- (1) Operational Readiness Inspection criteria for ACC
- (2) Operational Readiness Inspection criteria for AMC
- (3) Operational Readiness Inspection criteria for AFSOC

## ORI Criteria for ACC

Excerpts From *AFI 90-201, ACC SUPPLEMENT 1*, Part 2, (1996)

### Operational Readiness Inspection (ORI) Criteria (Pg. 42)

#### Section A - Chapter 2 - Initial Response

1.6.3. **ORI Scenarios.** Scenarios will be developed to evaluate the unit's capability to operate under their assigned wartime tasking. ORI scenarios and taskings should reflect the wartime/contingency mission(s) for the unit(s) being inspected based on current tasking and applicable theater concepts of operation.

1.6.3.2. **Fighter Sortie Rates.** Fighter units may be tasked by the IG at 125% of their sortie rates reflected in their DOC statement or 125% of the appropriate sortie surge rate as per tasked OPlan scenario, as determined by the IG. The IG will consider WMP rates, long range missions, composite/large force employment packages, daylight hours and nighttime tasking when determining the number of sorties to be tasked. Tasked sorties will normally be rounded to the nearest whole number divisible by 2.

1.6.3.3. **Tactical Airlift Sortie Rates.** C-130 units may be tasked by the IG at 125% of their DOC statement UTE rate averaged over the duration of the ORI or 125% of the appropriate surge sortie/hour rate as per the tasked OPlan scenario as determined by the IG. The total number of tasked missions will be those to meet airlift user requirements. The IG may task other "non-user" missions so that unit capabilities not required by a specific airlift customer can be rated. Additionally, flying time spent in ferrying empty aircraft between the FOB and FOL will be considered in determining sortie/flying hour tasking, but will not limit IG tasking in order to maintain an appropriate tasking tempo for the scenario.

1.6.3.4. **Reconnaissance Aircraft Sortie Rates.** U-2 Reconnaissance Aircraft may be tasked by the IG at DOC statement combat sortie rates. Real world operational mission tempo and aircraft availability will be considered when determining U-2 employment sortie rates.

1.6.3.5. **Other Aircraft Sortie Rates.** Rates will be determined for other aircraft in a similar manner as described in Part 2, paragraphs 1.6.3.2 and 1.6.3.3. Specifics will be provided to the unit via SPINs or ROE briefing prior to the ORI.

**2.1. Summary.** The **Initial Response** area of an ORI is an evaluation of the unit's capability to transition from peacetime to contingency operations or wartime posture, and includes all actions that normally occur prior to the outbreak of hostilities.

#### 2.5. Subarea – Generation.

2.5.1. **General.** The purpose of generation is to evaluate the ability of the unit to safely generate properly configured equipment (including aircraft) capable of performing the mission in support of the unit's war plan tasking, OPlans, and IG taskings. This will be accomplished by requiring the unit to generate equipment against an ORI ATO or wartime plan and may include electronic warfare (EW) systems reprogramming. Maintenance Support and Timing will be used to assess aircraft generation capability.

2.5.3. **Munitions Procedures.** Units will demonstrate munitions breakout, delivery, and loading capability for all generated aircraft. War Reserve Materiel (WRM) ammunition loading will be demonstrated by one of the following methods: (1) replacing the ammunition in loaded/partially loaded gun systems with a minimum of the same type/quantity of ammunition as previously loaded; (2) fully loading empty gun systems with TP ammunition; (3) cycling a minimum of 25 rounds of TP or dummy ammunition through empty gun systems, leaving the system empty or;

(4) connect the UALS to the gun system and cycle the system in “bypass” using dummy round markers in the UALS to indicate system capacity.

**2.5.5. Item – Maintenance Support.** The aircraft maintenance function will be evaluated on its ability to manage and control assigned resources, the content and use of generation plans, technical data compliance, combat capability of generated aircraft, and safety. Additionally, selected aircraft may receive systems reliability checks.

**2.5.7. Rating: Subarea – Generation.** The number of aircraft generated is critical and the quality of maintenance support may be used to raise or lower the overall aircraft generation rating. Each squadron will be rated IAW the unit’s war plan timing, IG tasking, or the applicable OPlan. The wing rating will be a combination of the number of aircraft generated, timing and the quality of maintenance support.

## **2.6. Subarea – Deployment (Personnel and/or Cargo).**

**2.6.1. General.** The deployment phase of an ORI is a results-oriented evaluation of a unit’s ability to deploy its combat capability using the process defined in its local deployment guidance. The effectiveness and efficiency of the local guidance in deploying a combat capability, within the parameters defined by higher headquarters guidance, will be evaluated during this phase of an ORI. When units deploy via support airlift, the IG will use suitability for movement and departure timing criteria to evaluate deployment. Units tasked to deploy by air after arrival at the Aerial Port of Embarkment (APOE), who are simulating movement to the APOE, will prepare all cargo for air shipment.

**2.7.1. Item – Maintenance Support.** The aircraft maintenance function will be evaluated on its ability to manage and control assigned resources, the content and use of plans, technical data compliance, aircraft combat capability, and safety.

### **2.7.2. Item – Number of Aircraft Successfully Deployed.**

#### **2.7.2.1. Rating: Item – Number of Aircraft Successfully Deployed.**

<b>Rating</b>	<b>Outstanding</b>	<b>Excellent</b>	<b>Satisfactory</b>	<b>Marginal</b>	<b>Unsatisfactory</b>
Scheduled Aircraft Arriving At Employment Base	All	One did not arrive	Two did not arrive	Three did not arrive	Four or more did not arrive

**2.7.5. Rating: Subarea – Aircraft Deployment.** The number of aircraft arriving at the employment base is critical, but the quality of maintenance support can be used to raise or lower the overall wing aircraft deployment rating.

**2.8. Subarea – Regeneration After Deployment.** This phase of the inspection evaluates the deployed unit’s ability to attain a combat ready posture for the in-theater commander as soon as possible after arriving at a deployment base. All aircraft arriving at the FOB will be regenerated. Only those personnel and equipment designated to deploy with the unit may be used for regeneration except as planned for and designated in Joint Support Plan (JSPs)/Base Support Plans (BSPs). Overall regeneration rating includes:

- Unit preplanning and knowledge of employment site to include site survey.
- A unit’s ability to effectively interface with a host base to establish initial operational capability.
- WOC/MOC/work centers setup and communications network to control and direct the work force during initial regeneration actions.

2.8.3. **Item – Maintenance Support.** The aircraft maintenance function will be evaluated on its ability to manage and control assigned resources, the content and use of regeneration plans, technical data compliance, combat capability of generated aircraft, and safety.

2.8.4. **Item – Aircraft Regeneration Timing.**

2.8.4.1. **Rating: Item – Aircraft Regeneration Timing.**

<b>RATING</b>	<b># Aircraft Regenerated</b>	<b>See Note 1</b>	<b>See Note 2</b>
<b>Outstanding</b>	All aircraft regenerated within	5 1/2 hrs	7 hrs
<b>Excellent</b>	All but one aircraft regenerated within	7 hrs	9 hrs
<b>Satisfactory</b>	All but two aircraft regenerated within	10 hrs	12 hrs
<b>Marginal</b>	All but three aircraft regenerated within	12 hrs	14 hrs
<b>Unsatisfactory</b>	Doesn't meet other criteria.		

### **Section B – Fighter Aircraft Criteria**

NOTE: All required Initial Response information is found in Part 2, Section A.

### **Section C – Bomber/Tanker Aircraft Criteria**

NOTE: For all Subareas, Items, Subitems which do not contain specific rating criteria, see Part 2, paragraph 1.3 rating criteria.

#### **2.10. Subarea – Generation.**

2.10.2. Munitions. The bomber conventional generation will include as a minimum complete pylon/bay loads and postload checks. If sufficient munitions are not available for all generated aircraft, the first few generated aircraft lines will receive a half up/half down load until sufficient munitions are available for remaining aircraft to receive a full load. Examples of half up/half down loads are: B-1 - one crew load fourteen stations in mid bay, another crew load fourteen stations in aft bay, then download stations and perform postload. B-52 - load two cluster racks internally and one pylon externally, postload, and then download to simulate full load timing. Simulate breakout, delivery and loading of flares with empty modules/dispensers. Do not load flares.

### **Section A - Chapter 3 - Employment**

3.1. **Summary.** The employment area of an ORI is an evaluation of a unit's ability to support and employ combat forces, provide aerial/ground control of air battle, support CINCs' infrastructure requirements through CE operations and provide continuous communications capability during contingencies or wartime.

#### **3.3. Overall Rating: Area – Employment.**

**Outstanding:** Operations outstanding, Maintenance and Command and Control at least excellent.

**Excellent:** Operations, Maintenance, and Command and Control at least excellent.

**Satisfactory:** Operations, Maintenance, and Command and Control at least satisfactory.

**Marginal:** Operations, Maintenance, or Command and Control marginal.

**Unsatisfactory:** Doesn't meet other criteria.

NOTE: MDS specific for maintenance with respect to aircraft.

3.4.2. **Item – Control of Maintenance.** Maintenance will be evaluated on the accuracy, timeliness, and adequacy of actions to receive, interpret, and disseminate tasking information from the WOC/command and control elements to flightline/work area supervisors. Both the primary and alternate Maintenance Operation Center (MOC) will be evaluated, including their ability to efficiently relocate as required by the exercise scenario. Communication and coordination with petroleum oil lubricants (POL) expeditors, supply, and munitions control/comparable non-flying related tasks will also be evaluated, as applicable.

**3.4.4. Item – Activation of Alternate Wing Operations Center.** Unit procedures for alerting the alternate WOC and transferring control quickly and efficiently, and the unit's continuing ability to exercise control functions without significant degradation of effectiveness will be evaluated. All deploying ACC units will be required to relocate their WOC to an alternate location. Equipment and manning will be at the discretion of the unit commander. The unit will provide the IG an informal briefing on limiting factors, such as communications shortfalls, location of alternate WOC, and manning upon arrival. Some degradation is expected.

### **3.5. Subarea – Maintenance.**

**3.5.1. Item – Maintenance Support.** The aircraft maintenance function will be evaluated on management practices used to produce quality maintenance in support of the unit's contingency tasking. The effectiveness of the unit's combat sortie generation plan will also be assessed. In general, the following is evaluated and will be considered in determining the unit's overall rating: direction and coordination of maintenance actions (include the assignment and control of personnel); cooperation between the maintenance units and agencies; information flow from the flightline to MOC; and supervisory involvement and decision-making. The proper use of technical data, safety protection gear, and AGE and test equipment; accuracy of aircraft forms documentation; prioritization of shop tasks; repair of aircraft components; radio discipline; foreign object damage awareness; and, if used, hot refueling procedures are also considered. Combat turns that do not involve concurrent servicing actions will be graded in this item. Overall planning for the employment ORI will be assessed against real world contingency plans. Included are appropriate sense of urgency, security response, motivation, teamwork, and esprit de corps.

**3.5.2. Item – Sortie Generation.** The sortie generation phase evaluates the unit's ability to provide mission capable aircraft to meet ORI employment tasking. Prior to initiation of employment operations, the unit provides the IG with tail number identification of those unit aircraft selected for employment use. Remaining aircraft are considered nonexistent and will not be used in any way to support the sortie generation/combat employment effort unless authorized by the IG. The IG will validate remaining aircraft to determine if additional aircraft (not to exceed PAI) could have been brought up to mission capable status. For units employing in place, sortie generation (SG) aircraft baseline is PAI. For deploying units, the SG baseline is the number of aircraft tasked to deploy IAW the unit's war plan requirements/OPlan tasking. All sorties flown by employment-identified mission capable aircraft during the employment phase (including inspection support) count toward sortie generation if they meet the criteria for an effective sortie. IG tasking during the employment phase will be a wartime rate based on the applicable unit's war plan requirements/OPlan or gaining command estimates. (In some cases, sortie rates tasked during an ORI will differ from these rates due to the necessity to obtain measurable sample sizes). Sorties lost due to circumstances beyond the unit's control, such as weather or Higher Headquarters (HHQ) cancellations, will not be counted against the unit. Sorties will not be added by the unit to make up for previous losses or to exceed IG tasking; however, the IG may offer additional taskings to offset losses beyond the unit's control. Applicable aircraft that cannot be released from alert, HHD missions, or transfer preparation will be subtracted from the authorized aircraft figures to determine available aircraft for tasking. Transfer preparation aircraft must be coordinated with the IG Team Chief. All functions necessary to turn aircraft for the next mission will be accomplished. Aircraft that the unit has provided specifically for IG pilots to fly will be turned by the unit or as coordinated with the IG. Units can expect to perform some combat turns/dual loading operations in a chemical environment (N/A for 1AF units). SG results for combined/large force employment may be rated separately. Fleet status is reviewed at the start of flying and at the termination of flying. This is determined by counting the number of baseline aircraft that are mission capable (MC). Abort

rates are reviewed during employment phase. Both air and ground aborts are counted to compute a total abort rate. Sorties noneffective due to factors beyond unit control are not included in performance computations and the IG will adjust missions tasked/scheduled sorties accordingly. To be effective a generated sortie must meet the following criteria:

- Aircraft configured IAW the ATO or other IG tasking.
- Aircraft systems effectively meet specific mission requirements (e.g. Maverick, air intercept, weapons control systems, reconnaissance sensors and EC/EA systems, etc.).
- Generated in time to meet its mission profile/TOT requirements.

**3.5.3. Item – Aircraft Systems Reliability (Bombers/Fighters).** The unit will provide people and equipment for the reliability checks. Headsets, communications Y-cords, and technical data will be provided to the IG during the checks. Aircraft tested will be selected by the IG. If test equipment is suspected to be faulty, it must be substantiated. No maintenance will be performed on the aircraft system until replacement test equipment completes testing the aircraft.

**3.5.4.1.2. Element – Munitions Loading.** All loadings are subject to evaluation. The IG will primarily evaluate loadings conducted as an integral part of aircraft sortie generation. Evaluation of conventional loading may be conducted in the load crew training facility if required. Crew performance and adherence to technical directives are evaluated. Particular emphasis will be placed on safety, security, reliability, procedural directives, and specific technical data requirements during all loading operations.

- Bomb/Missiles. Loading may be demonstrated by uploading and downloading half standard load of tasked munitions. Tasked munitions will be drawn from the unit's primary munitions listing or by special ATO tasking. **Fighter aircraft** will include a half upload and download of available bomb/missile stations. Bomber aircraft conventional sortie generation will include as a minimum, complete pylon/bay loads and post load checks. For example: **B-1B** units will fully load one bay, post load, and then unload that bay to simulate a full load. **B-52** units will load two cluster bomb racks internal and one full pylon, post load, and then unload to simulate a full load.
- Chaff/Flares. During munitions loading operations qualified personnel will load/unload or unload/load as applicable, one-half of each aircraft's full complement of required modules, retainer assemblies, or trays. Flare loading will be simulated unless required for live drops.

**NOTE:** Bombers. When applicable, load sufficient training chaff to accomplish exercise requirements. For B-1s: if RR-188 training chaff is not available, load sufficient RR-170 chaff to accomplish the exercise, commensurate with the frequency clearances.

- Loading Simulation. Simulate by positioning the load crews at the appropriate aircraft section for the time on the unit's AF Form 2408, Generation Maintenance Plan, or AF Form 2409, Generation Sequence Action.
- Delivery Demonstration. Demonstrate the ability to deliver flares to the flightline.

**3.5.5. Rating: Subarea – Maintenance (Rescue, Command & Control/Reconnaissance and Theater Airlift aircraft only).**

**Outstanding:** Sortie Generation plus one outstanding with remaining excellent.

**Excellent:** Sortie Generation plus one excellent with remaining at least satisfactory.

**Satisfactory:** Sortie Generation satisfactory with only one marginal.

**Marginal:** Sortie Generation at least marginal with only one unsatisfactory.

**Unsatisfactory:** Doesn't meet other criteria.

**3.5.6. Rating: Subarea – Maintenance (Applies to all other aircraft types).**

**Outstanding:** Sortie Generation plus two outstanding, one excellent and one satisfactory.

**Excellent:** Sortie Generation plus two excellent with remaining satisfactory.

**Satisfactory:** Sortie Generation satisfactory with only two marginal.

**Marginal:** Sortie Generation at least marginal with only two unsatisfactory.

**Unsatisfactory:** Doesn't meet other criteria.

**3.6. Subarea – Operations.** Units (wings, groups, and squadrons) will be evaluated/rated on their capability to perform their assigned missions as per their DOC statements. Realism will be attempted whenever possible and simulations will be minimized. Operations will be rated on these major items as applicable: CSE, Intelligence, Aircrew Life Support, Weather Support and Air Traffic Services. The interrelationships of these items will be carefully considered in the overall operations rating.

**3.6.2. Item – Combat Sortie Effectiveness.**

**3.6.2.1. Subitem – Mission Results.** This subitem will be rated for each combat role and will be derived from the percentage of CSE/mission execution effective sorties. Sorties may be assessed as non-effective for CSE at the discretion of the IG due to improperly briefed flight procedures, poor tactics or execution, substandard weapons/weapons system employment, failure to meet timing criteria, inadequate visual lookout/defensive reactions, failure to adhere to training rules, poor flight integrity, maintenance, command and control, or when flights are conducted in such a way as would result in a friendly aircraft loss.

**3.6.2.1.1. Rating: Subitem – Mission Results.**

Rating	Outstanding	Excellent	Satisfactory	Marginal	Unsatisfactory
Effective Sorties	95 to 100%	85 to 94.9%	75 to 84.9%	65 to 74.9%	< 65%

**Section B – Fighter Aircraft Criteria**

**NOTES:**

1. For all Subareas, Items, Subitems which do not contain specific rating criteria, see Part 2, paragraph 1.3 rating criteria.
2. For Command and control criteria see Part 2, paragraph 3.4.

**3.7. Subarea – Fighter Aircraft Maintenance.**

**3.7.1. Rating: Item – Sortie Generation.** Ratings for sortie generation effectiveness will be determined by the percentage of IG tasked sorties which are effectively generated.

Rating	Outstanding	Excellent	Satisfactory	Marginal	Unsatisfactory
Sortie Generation	97 to 100%	92 to 96.9%	87 to 91.9%	78 to 86.9%	< 78%

**3.7.2. Item – Integrated Combat Turnaround (ICT).** ICTs will be a graded area for those units directed to perform these procedures as per MCR 60-6, or for units electing to perform ICTs for sortie generation.

**NOTE:** Units must clarify the actual loading/downloading procedures as well as type of munition(s) that will be used during the inspection with the IG during pre-inspection planning meetings.

- Units are rated on their ability to turn aircraft using applicable ICT procedures. The unit's management decisions on which and how many aircraft to ICT must be based on ATO requirements, resources available, facilities and geography at the ORI scenario location.
- ICTs should be accomplished in revetments, protective shelters, or other similar areas

appropriate for the employment theater. All functions necessary to prepare the aircraft for its next mission will be accomplished. The actions do not have to be performed in one location (i.e. Hot Pits). Tasked munitions will be according to the ATO designated standard conventional load(s) (SCL). Units can expect to perform some ICTs in chemical gear.

- During designated ICTs, the unit may be tasked to reconfigure aircraft with external fuel tanks up to expenditure per sortie factor (EPSF) rates.

### **3.8. Subarea – Fighter Operations.**

**3.8.1. Item – Combat Sortie Effectiveness.** Use Part 2, paragraph 3.6.2 and the information listed below as applicable to unit's fighter operations.

**3.8.1.1. Subitem – Mission Results.** This subitem will be rated for each combat role using the data in Part 2, paragraph 3.6.2.1.1. Sorties flown by evaluators who act as an integral member of the flight will be considered as effective; however, weapons deliveries will not be included in weapons employment data.

#### **3.8.1.2. Subitem – Response Timing.**

- To meet the specified timing criteria, missions with an assigned time on station (TOS), cap vulnerability time, or force rendezvous time, must arrive no later than 5 minutes after the assigned time or the beginning of the vulnerability window. Aircraft operating in support of or as part of a strike package must rendezvous so as to meet assigned tasking/position. Aircraft with an assigned time on target (TOT) window should complete all weapons deliveries within window to include reattacks. FAC sorties must be on station in sufficient time to get fighter ordnance on target during portion of the assigned area time. Missions delayed by factors beyond the unit's control will not be counted.
- AD and CAS alert scramble response timing starts with receipt of a scramble order at the unit WOC and terminates when the scrambled aircraft initiates continuous taxiing for the active runway/quick check area. When conflicts in taxi order exist and one aircraft must hold for another, the holding aircraft must accomplish tire roll-over to terminate scramble timing. Scrambled aircraft will not delay takeoff due to IG chase requirements. AD scramble timing is 5 minutes; CAS alert scramble timing criteria is 8 minutes.
- For Airborne Order (ABO) launch, timing criteria are NLT the ABO and NET 5 minutes prior. Late takeoffs caused by factors beyond the unit's control, as validated by the IG, will not be charged. If a primary aircraft ground aborts, it may be replaced by a spare. However, if neither the primary nor spare aircraft meets scramble/ABO criteria, a late response is charged.

##### **3.8.1.2.1. Rating: Subitem – Response Timing.**

<b>Rating</b>	<b>Outstanding</b>	<b>Excellent</b>	<b>Satisfactory</b>	<b>Marginal</b>	<b>Unsatisfactory</b>
<b>% Meeting Timing</b>	<b>96 to 100%</b>	<b>87 to 95.9%</b>	<b>78 to 86.9%</b>	<b>70 to 77.9%</b>	<b>&lt; 70%</b>

**3.8.1.3. Subitem – Intercept Success.** Applicable fighter units will be objectively rated on their ability to intercept and subsequently escort/ID/destroy targets IAW assigned tasking.

##### **3.8.1.3.1. Rating: Subitem – Intercept Success.**

<b>Rating</b>	<b>Outstanding</b>	<b>Excellent</b>	<b>Satisfactory</b>	<b>Marginal</b>	<b>Unsatisfactory</b>
<b>Controlled</b>	<b>96 to 100%</b>	<b>87 to 95.9%</b>	<b>78 to 86.9%</b>	<b>70 to 77.9%</b>	<b>&lt; 70%</b>
<b>Autonomous</b>	<b>90 to 100%</b>	<b>80 to 89.9%</b>	<b>70 to 79.9%</b>	<b>60 to 69.9%</b>	<b>&lt; 60%</b>

### **Section C – Bomber Aircraft Criteria**

**NOTE:** For all Subareas, Items, Subitems which do not contain specific rating criteria, see Part 2, paragraph 1.3 rating criteria.

#### **3.9. Subarea – Aircraft Maintenance.**

**3.9.1. Rating: Item – Sortie Generation.** Ratings for sortie generation effectiveness will be determined by the percentage of ATO/OPlan tasked sorties which are effectively generated.

<b>Rating</b>	<b>Outstanding</b>	<b>Excellent</b>	<b>Satisfactory</b>	<b>Marginal</b>	<b>Unsatisfactory</b>
<b>Sortie Generation</b>	<b>97 to 100%</b>	<b>83 to 96.9%</b>	<b>66 to 82.9%</b>	<b>50 to 65.9%</b>	<b>&lt; 50%</b>

#### **3.10. Subarea – Operations.**

##### **3.10.1. Item – Combat Sortie Effectiveness.**

**3.10.1.1. Subitem – Weapons/Weapons System Employment.** Will be rated for each applicable combat role a unit may be tasked to perform. Effectiveness is the average of Weapons Employment (WE) and Probability to Penetrate (PTP).

**3.10.1.6. Element – Probability to Penetrate (PTP).** PTP is made up of three factors: Penetration Altitude Factor (PAF), Threat Avoidance Factor (THAF), and Bomber Defense Factor (BDF). Sortie PTP is determined by multiplying the three factors together ( $PTP = PAF \times THAF \times BDF$ ). Determine each of these factors by an inflight Performance Factor (IPF) when the desired activity is adequately evaluated. The IPF measures the combined crew performance and equipment status together. Additionally, for BDF, when the activity cannot be evaluated inflight, use an Equipment Performance Factor (EPF) instead of the IPF. When EPF's are used, include equipment that is inoperative prior to takeoff or landing, at the time of an air abort, or at a time which prevents applicable activity from being accomplished.

### **Section D – Special Mission Aircraft Criteria.**

#### **NOTES:**

1. This section applies to reconnaissance, command and control, EW and any other special mission aircraft not addressed in other sections.
2. For all Subareas, Items, Subitems which do not contain specific rating criteria, see Part 2, paragraph 1.3 rating criteria.

#### **3.12. Subarea – Aircraft Maintenance.**

##### **3.12.1. Item – Sortie Generation.**

##### **3.12.1.1. Rating: Item – Sortie Generation.**

<b>Tasked Sorties</b>	<b>EFFECTIVE SORTIES</b>				
	<b>Outstanding</b>	<b>Excellent</b>	<b>Satisfactory</b>	<b>Marginal</b>	<b>Unsatisfactory</b>
13+	92 to 100%	84 to 91.9%	76 to 83.9%	69 to 75.9%	< 69%
12	12	11	10	9	7 or less
11	11	10	9	8	7 or less
10	10	9	8	7	6 or less
9	9	8	7	6	5 or less
8	8	7	6	5	4 or less
7	7	6	5	4	3 or less

**NOTE:** For 2 to 6 tasked sorties, all must be effective for an outstanding, all but one must be effective for a satisfactory, and more than one non-effective sortie is an unsatisfactory.

### **3.13. Subarea – Operations.**

#### **3.13.1. Item – Combat Sortie Effectiveness.**

##### ***Section E – Theater Airlift Criteria***

**NOTE:** For all Subareas, Items, Subitems which do not contain specific rating criteria, see Part 2, paragraph 1.3 rating criteria.

### **3.28. Subarea – Maintenance.**

#### **3.28.1. Rating: Item – Sortie Generation.**

<b>Rating</b>	<b>Outstanding</b>	<b>Excellent</b>	<b>Satisfactory</b>	<b>Marginal</b>	<b>Unsatisfactory</b>
<b>Percent</b>	<b>96 to 100%</b>	<b>91 to 95.9%</b>	<b>81 to 90.9%</b>	<b>78 to 80.9%</b>	<b>&lt; 78%</b>

### **3.29. Subarea – Operations.**

**3.29.1. Item – Combat Sortie Effectiveness.** The CSE grade will measure combat delivery effectiveness.

**3.29.1.2.1. Element – Time-over-Target (TOT).** To be effective, the serial lead's TOT must be within the following criteria: ≤ 60 seconds visual or ≤ 90 seconds SKE. Rating for this element will be based upon percentage of missions meeting this criteria according to Part 2, paragraphs 1.9.4. or 1.9.5.

**NOTE:** Record TOT when the serial lead navigator announces “green light” for an airdrop or extraction. Evaluate the TOT for each formation lead or single ship aircraft. A lead aircraft is any aircraft crossing the DZ without direct navigation reference to another aircraft. Grade only the first aircraft in a one-minute VFR corridor for TOT. Overall grade is based on the average deviation for all lead aircraft for each aerial delivery event.

**3.29.1.2.2. Element – Airdrop Accuracy.** For an effective personnel drop, the first jumper from each aircraft must land within the minimum size DZ, as computed according to AMCR 55-60 (with appropriate adjustments for night airdrops, formation airdrops, SKE airdrops, etc.) for a single jumper. All remaining jumpers must land within the parameters of the surveyed DZ. All equipment loads (HE, CDS) must land within the minimum-size DZ, as computed according to AMCR 55-60 (with appropriate adjustments for night airdrops, formation airdrops, SKE airdrops, etc.). The IG will attempt to determine the cause of each no-drop or ineffective drop. If the ineffective drop is user-caused or the cause cannot be determined, the sortie may be dropped from the database. If the ineffective drop resulted from aircrew error, the load will be scored as ineffective. In the ORI report, the IG will rate each type of airdrop (CDS, Personnel, HE) separately; however, the airdrop accuracy element rating will be the aggregate of all type airdrops. The percentage of successful airdrops determines the rating for this element according to Part 2, paragraphs 1.9.4 or 1.9.5.

## **ORI Criteria for AMC**

Excerpts From *AMCI 90-201*, (1996)

### **Operational Readiness Inspections (Pg. 15)**

#### **3.1. General:**

3.1.1. Concept. HQ AMC/IG conducts ORIs of AMC and AMC-gained ANG and AFRES units. When directed by AMC/CC, units may receive an ORI regardless of their reported capability. Emphasis will be placed on multi-unit and multi-MAJCOM inspections.

3.1.3. Major Graded Areas. The four major graded areas comprising an ORI are Initial Response, Employment, Mission Support, and ATSO. Inspectors will evaluate the following processes in all major graded areas throughout the inspection.

3.1.3.3. Safety. Evaluate the unit's safety awareness throughout the ORI. Unit commanders may cancel or deviate from any part of the ORI when conditions compromise safety. Advise the AMC/IG functional area inspector of the reasons for the cancellation or deviation.

#### **3.4. Initial Response:**

3.4.1. General. The desired outcome of initial response is the rapid and effective transition from a peacetime to contingency and wartime posture. The initial response processes include C<sup>2</sup>, teamwork, mobility, deployment, and SIOP. The IG will evaluate the unit's ability to command, control, and execute assigned taskings, including readiness posture changes, aircraft generation, mobility operations, deployment of personnel and equipment, and SIOP alert operations (where applicable). For those units with a SIOP and a tactical or mobility DOC, transition between wartime postures will be scenario driven.

3.4.2.7. Maintenance Management. Observe all areas and levels of maintenance management on the positive control of maintenance efforts and the satisfactory accomplishment of management and maintenance actions. This is to include the coordination and teamwork between operations, maintenance, and other functional areas concerning systems requirements and upload, as well as configuration, system inspection, and munitions upload. Consider the overall planning, implementation, efficient, and successful accomplishment of actions.

3.4.2.7.1. Maintenance control and coordination. Maintenance decision-makers should, as a minimum:

3.4.2.7.1.1. Logically sequence and plan adjustments to schedule aircraft to meet generation requirements, efficiently use available maintenance resources and coordinate timely support by other functions.

3.4.2.7.1.2. Maintain accurate status and forms documentation of aircraft critical support equipment (SE) and aerospace ground equipment (AGE).

3.4.2.7.1.3. Pass accurate, appropriate and timely information to other controlling agencies and maintenance personnel. Maintain effective OPSEC and COMSEC.

3.4.2.7.1.4. Identify and attempt to resolve LIMFACs.

3.4.2.7.1.5. Use coordination and encourage teamwork to accomplish mission taskings. Identify potential problems and participate in both resolution and execution of corrective actions.

3.4.2.7.1.6. Establish and maintain work priorities.

3.4.2.7.1.7. Maintain and manage management information system during power outage.

- 3.4.2.7.2. Resource Management. Observe the management of personnel and SE/AGE to:
- 3.4.2.7.2.1. Establish effective work schedules to achieve maximum capability with assigned personnel.
  - 3.4.2.7.2.2. Accurately identify and process supply requests.
  - 3.4.2.7.2.3. Effectively cross-utilize skills to handle surges and priority requirements.
  - 3.4.2.7.2.4. Provide adequate supervision and assign personnel tasks commensurate with their skill level and training.
  - 3.4.2.7.2.5. Ensure support equipment is serviceable, accounted for, available and properly calibrated. This includes powered and non-powered AGE, precision measurement equipment (PME), composite tool kits (CTK), SE and special tools, as well as the support equipment furnished by the host at the deployed location.
  - 3.4.2.7.2.6. Ensure procedures are established and utilized for the management of hazardous waste.
- 3.4.2.7.3. Ensure the cannibalization of aircraft components from nonpossessed aircraft or any which are not ORI available, is coordinated with IG and approved by HQ AMC/LGS.
- 3.4.2.9. Supply Readiness Control Center. Assess its ability to interface with appropriate work centers to ensure all deploying personnel are properly equipped. Also review the unit's process for control and accountability of mission readiness spares package (MRSP) assets and support equipment.
- 3.4.2.12. Airfield Operations. Assess the ability of the airfield operations flight to meet mobilization requirements during initial response.
- 3.4.4. Mobility. Assess the deployment process and unit capability to implement and execute higher headquarters taskings and use of locally developed guidance to implement tasking orders. As a minimum, consider the following when evaluating this area:
- 3.4.4.1. Coordination among cross-functional units.
  - 3.4.4.2. Cargo Deployment Function (CDF). Evaluate how the unit monitors all cargo processing activities and the effectiveness of passenger service and air freight operations. Additionally, evaluate the CDF on surface and commercial movements other than by military or civilian aircraft. The unit must further demonstrate ability to plan or coordinate passengers and cargo movement by commercial transportation, organic, vehicle convoy, and other modes of transportation.
    - 3.4.4.2.1. Roller requirements for KC-135 aircraft. Units will be required to demonstrate existing capability. Load one aircraft per possessed roller kit with palletized cargo.
    - 3.4.4.3. Personnel deployment function (PDF). Evaluate how the unit monitors all personnel processing activities. Assess how well the PDF orchestrated the efforts of the unit to ensure all mobility personnel were properly prepared for deployment in accordance with the installation deployment guidance. Areas evaluated include management, higher headquarters reports processing, orders preparation, personnel processing, Manpower Personnel Module System (MANPER), and updating and generating reports.
    - 3.4.4.4. Unit Actions. Evaluate how the unit prepares personnel and equipment in support of deployments. Units brief deploying personnel on proper equipment loading of commercial aircraft and of items prohibited onboard. Firearms will be unloaded, magazine removed, and the safety on. For tenant units, also evaluate unit representative's ability to assist the host IDO during deployments involving the tenant.

3.4.4.4.4. Supply. Assess the unit's process for the issue of required individual mobility gear (A, B, C, and E bag items) to deploying personnel; as well as the unit's process for controlling the accountability of deployed equipment and MRSP.

3.4.4.4.5. Maintenance. Assess maintenance's ability to plan and mobilize its force for deployment. Ensure all shortages and shortfalls are communicated to the DCC. Deploying equipment will be serviceable, accounted for, and calibrated. Compare deploying kit/package contents, placard weight, and volume to UTC packaging list.

3.4.5.1.1. Takeoff Time. The first takeoff of each aircraft at home station will validate that aircraft's generation. It will be considered taking place under Initial Response, and will be evaluated appropriately. Aircraft must take off on time and be properly configured. All subsequent takeoffs for round robin missions from home station will be evaluated during the employment phase. This applies to both generation and mobility forces:

3.4.5.1.1.1. Each aircraft must depart home station in accordance with the published schedule or no later than the latest time for mission completion.

3.4.5.1.1.2. Units may continue to perform maintenance on aircraft in depot status.

### **3.5. Employment:**

3.5.1. General. The desired outcome of employment is the safe delivery of, passengers, patients, troops, fuel and cargo to the correct place, in the proper sequence, and on time. The employment processes include C<sup>2</sup>, teamwork, mission generation, and mission execution. The IG will evaluate AMC forces performing airland, aerial delivery, aerial refueling, aeromedical staging, aeromedical evacuation, and other unique missions in the employment phase.

3.5.2.2. Maintenance Management. Observe all areas of maintenance to assess the efficiency of maintenance efforts and satisfactory accomplishment of management actions. This will include the coordination between operations, maintenance and other functional areas concerning systems requirements and upload, as well as the aircraft configuration, system inspection and munitions upload.

3.5.2.2.1. Maintenance Control and Coordination. Observe all levels of maintenance control on overall planning, implementation, positive control and successful accomplishment of actions. Maintenance decision-makers should, as a minimum:

3.5.2.2.1.1. Logically sequence and plan adjustments to schedule aircraft to meet generation requirements, efficiently use available maintenance resources and coordinate timely support by other functions.

3.5.2.2.1.2. Maintain accurate status and forms documentation of aircraft and critical SE/AGE.

3.5.2.2.1.3. Pass accurate, appropriate and timely information to other controlling agencies and maintenance personnel. Maintain effective OPSEC and COMSEC.

3.5.2.2.1.4. Identify and attempt to resolve LIMFACs.

3.5.2.2.1.5. Use coordination and encourage teamwork to accomplish mission taskings. Identify potential problems and participate in both resolution and execution of corrective actions.

3.5.2.2.1.6. Establish and maintain work priorities.

3.5.2.2.1.7. Maintain and manage management information system during power outages.

3.5.2.2.2.7. Ensure proper Foreign Object Damage (FOD) prevention management at all deployed locations.

3.5.2.4.3. Maintenance Aircraft Coordination Center (MACC).

- 3.5.2.4.3.1. Tasking messages received, understood, coordinated, disseminated, and acted upon in a timely manner.
- 3.5.2.4.3.2. OPSEC/COMSEC/COMPUSEC procedures enforced.
- 3.5.2.4.3.3. Provide positive direction and coordination of aircraft maintenance operations.
- 3.5.2.4.3.4. Procedures and priorities established to direct and coordinate maintenance support to originating and transiting intertheater and intratheater chopped AMC missions, including OSA and CRAF.
- 3.5.2.4.3.5. Establish and maintain proper accounting of resources, including critical SE/AGE.
- 3.5.2.4.3.6. TALCE/MST and other controlling agencies kept abreast of maintenance status in a timely manner. Problems anticipated to ensure effective decision-making.
- 3.5.2.4.3.7. Leadership/management effectively controlled mission accomplishment.
- 3.5.4. Mission Generation. Grade the employment mission generation procedures against the following criteria, as appropriate:
  - 3.5.4.1. Aircraft Generation. Aircraft generation will be evaluated based on the efficiency and effectiveness of all phases of the generation process including, as a minimum, aircraft recovery, servicing, ground handling and safety, launching, OPSEC and COMSEC, and the serviceability and safe use of direct support equipment. Special emphasis will be placed on teamwork, leadership and cooperation between everyone involved in the process (i.e., aerial port, aeromedical staging, AE, aircraft maintenance, fuels, operations and supply). Observe the unit's ability to prepare the aircraft for the aircrew and the aircrew's acceptance of the aircraft with all inspections, configurations and equipment, servicing and necessary maintenance actions complete so the aircraft is ready to meet scheduled mission taskings.
    - 3.5.4.1.1. Aircraft recovery, servicing, ground handling, and launch operations were conducted safely and efficiently.
    - 3.5.4.1.2. Aircraft were prepared for aircrew acceptance.
    - 3.5.4.1.3. Tools and equipment used in support of aircraft generation were serviceable and used in a safe manner to meet inspection, servicing, and maintenance requirements.
    - 3.5.4.1.4. Personnel performing generation and aircraft preparation tasks are knowledgeable and qualified to perform duties.
- 3.5.5. Mission Execution:
  - 3.5.5.1.1. Ability of unit aircrews to fly the planned mission, including aerial refueling or tactical instrument meteorological conditions (IMC) or visual meteorological conditions (VMC) training profiles, if applicable.
    - 3.5.5.1.1.1. Completion of all mission taskings.
    - 3.5.5.1.1.2. Application of effective crew resource management.
  - 3.5.5.1.2. Threat Recognition and Assessment. Evaluate operations personnel's knowledge of enemy threats, doctrine, weapons capabilities and countermeasures during their execution process. Additionally, consider the aircrews' capability to apply appropriate tactics when given inflight threat scenario updates.
  - 3.5.5.1.5. Mission Effectiveness. Each sortie and mission was effective if: cargo, passengers and troops were delivered on time without potential damage or injury sustained; it completed all

critical mission taskings, allowing the customer to successfully meet their taskings and requirements; a reliable air refueling as tanker or receiver is accomplished, if required.

3.5.5.1.9. Evaluate unit's execution of tactical deception (TD) plan.

3.5.5.2. Airland. As tasked, evaluate the unit's ability to transport supported force personnel and equipment to an objective base and conduct air refueling operations. Air refueling units with a cargo airlift capability will be evaluated using criteria in this section, as applicable.

3.5.5.2.1. Ninety percent (90%) of all airland missions must be completed in a safe, timely and effective manner.

3.5.5.2.2. Ninety percent (90%) of all shortfield landings must be completed in a safe, timely, and effective manner.

3.5.5.2.3. Evaluate the unit's ability to apply appropriate tactics and threat avoidance measures to counter air and ground threats.

3.5.5.2.4. Evaluate the units ability to fly the route as planned, coordinated, and directed.

3.5.5.2.5. Evaluate the unit's ability to safely and effectively perform engine running on/offload (ERO) operations. Scheduled ground times for EROs will be minimized, yet consistent with the type load, type aircraft, threat at onload or offload site, and support capability. Conduct EROs only with compatible loads and in accordance with applicable AMCI 11-series publications. The inspected unit and customer will coordinate and identify all non-compatible ERO cargo items. EROs will be considered effective if units successfully complete the operation within the scheduled ground time. Furthermore, any damage to aircraft or equipment, or personal injury sustained will result in an ineffective sortie. To meet standards, a 90 percent effective rate is required. The ground support team and aircrews will be evaluated on their ability to follow established ERO procedures, resulting in the safe and successful completion of the onload/offload within the tasked time period.

3.5.5.2.6. Evaluate the unit's ability to safely and effectively perform combat offload operations. Scheduled ground times for combat offload operations will be minimized, yet consistent with the type load, type aircraft, threat at offload site and support capability. Conduct combat offload operations only with compatible loads and in accordance with applicable AMCI 11-series publications. The inspected unit and customer will coordinate and identify all non-compatible combat offload cargo items. Combat offload operations will be considered successful if units effectively complete the operation within the scheduled ground time. Furthermore, any damage to aircraft or equipment, or personal injury sustained will result in an ineffective sortie. To meet standards, a 90 percent effective rate is required. The ground support team and aircrews will be evaluated on their ability to follow established combat off-load procedures, resulting in the safe and successful completion of the offload within the tasked time period.

3.5.5.2.7. Evaluate the unit's ability to safely and effectively perform emergency nuclear airlift force (ENAF) operations. Scheduled ground times for ENAF operations will be minimized, yet consistent with the type load, type aircraft, threat at onload or offload site and support capability. Conduct ENAF operations in accordance with applicable AFI 91-series and AMCI 11-series publications. ENAF operations will be considered successful if units effectively load plan, complete the operation within the scheduled ground time, and follow applicable publication instructions. Furthermore, any damage to aircraft or equipment, or personal injury sustained, will result in an ineffective sortie. To meet standards, a 100 percent effective rate is required.

3.5.5.2.8. Evaluate the unit's ability to safely and effectively perform emergency airlift of personnel. Scheduled ground times for emergency airlift of personnel operations will be minimized, yet consistent with the type load, type aircraft, threat at onload or offload site and

support capability. Conduct operations in accordance with applicable AMCI 11-series publications. Emergency airlift of personnel operations will be considered successful if units effectively complete the operation within the scheduled ground time, and follow applicable publication instructions. Furthermore, any damage to aircraft or equipment, or personal injury sustained, will result in an ineffective sortie. To meet standards, a 90 percent effective rate is required.

3.5.5.3.4. Time Over Target (TOT) Standard. Paratroops, heavy equipment platforms, or CDS containers must exit the aircraft within plus or minus 60 seconds of the scheduled TOT.

3.5.5.3.5. Personnel Airdrop Accuracy Standard. The first jumper from each aircraft must land within the minimum size DZ. DZ size will be computed using AFI 13-217 with appropriate adjustments for night airdrops, formation airdrops, etc. for a single jumper. *NOTE:* This requirement results from the US Army's need to use the entire length of the surveyed DZ regardless of the number of paratroops.

3.5.5.3.6. Heavy Equipment or CDS Airdrop Accuracy Standard. Ninety percent (90%) of each aircraft's airdrop load must land within the minimum size DZ. DZ size will be computed using AFI 13-217 with appropriate adjustments for night airdrops, formation airdrops, etc. Airdrop accuracy will be based on the first platform to exit the aircraft on each pass over the DZ. Score the wingman's drop with relationship to the serial/element lead's drop score in accordance with MCI/AMCI 11-2XX series regulations guidance for SKE-only units.

3.5.5.3.7. Aircrew Effectiveness. Evaluate the ability of the unit's aircrews to fly the planned mission, including aerial refueling, if required. The following results will indicate ineffective sorties:

3.5.5.4. Air Refueling. Evaluate the unit's ability to provide air refueling services to users as directed. As a minimum, consider the following when evaluating this area:

3.5.5.4.2. Routes and air refueling altitudes are flown as planned, coordinated, and directed.

3.5.5.4.4. Fuel delivery is safely executed as planned, coordinated, and directed.

3.5.5.4.5. Aircraft cell formation procedures and tactics were applied IAW applicable instructions.

3.5.5.4.6. Ninety percent (90%) of air refueling missions must meet scheduled timing and be able to deliver requested or scheduled offload, whichever is less.

3.5.5.4.7. Ninety percent (90%) of airland missions completed in a safe, timely, and effective manner (see paragraph 3.5.5.2.).

### **3.6. Mission Support:**

3.6.4.2. Supply. Evaluation of supply and fuels support is based on the organization's ability to sustain material and fuels support in response to wartime mission taskings. As an integral part of combat and airlift forces, emphasis is to provide simple, responsive, quality support to the customer.

3.6.4.2.1. Unit continues to maintain efficient prompt supply and fuels support to home station and deployed unit taskings.

3.6.4.2.2. Deployed readiness spares package (RSP) personnel coordinate with the maintenance control operation to ensure needed assets are properly identified and received expeditiously.

3.6.4.2.3. Proper accountability, replenishment, and control are maintained over deployed RSP assets.

3.6.4.2.4. Deployed fuels' personnel successfully integrate into host unit operations.

3.6.4.2.5. Aircraft are properly and safely refueled and defueled.

3.6.5. Redeployment.

3.6.5.3. Aircraft Maintenance. Evaluate the ability of the aircraft maintenance force to perform all required clearance activities in a timely and efficient manner. As a minimum, these should include the disposal of environmental damaging substances and cleanliness of maintenance areas, accounting for tools and parts redeploying, support equipment preparation for redeployment, and the proper configuration of aircraft.

### **3.8. Air Mobility Systems Impacts:**

3.8.1. Status of Resources and Training Systems.

3.8.1.1. Combat readiness reporting. Each SORTS-measured organization (to include supporting resource units) and the reporting agency are responsible for the implementation of combat readiness reporting in accordance with applicable directives and local procedures. Grade SORTS on the accuracy of stated C-level, identified LIMFACs relative to the unit's DOC statement, and effectiveness of local procedures. Apply SORTS measurements criteria to reported status and identified LIMFACs. Determine whether local instructions provide required taskings and procedures to allow the SORTS-measured units to accomplish an accurate and timely report.

3.8.1.2. SORTS-measured unit. Evaluate each SORTS-measured unit.

3.8.1.3. Local reporting agency. Evaluate the local reporting agency (command post, operations center, etc.).

**ORI Criteria for AFSOC**  
Excerpts From *AFI 90-201/AFSOC SUP 1*, (1995)

**Section E - Unit Employment (Chapter 6, Pg. 12)**

**6.14. Grading:**

6.14.3. Employment Event. For the purpose of this paragraph, define event as the outcome of a single task assigned to an aircrew/team during an employment mission. Most special operations missions normally include multiple events (e.g., air refueling, followed by an airdrop, then a blacked-out landing). In this instance, if an aircrew/team accomplishes one event, but another event is not completed for reasons other than those described in paragraph 6.17., include only the completed event in the database. Inspectors will comment on the overall outcomes of similar events in the report.

6.14.4. Rate Electronic Warfare/Self-Defense Capability as described in paragraph number 6.17.10.

6.14.5. For those weapon systems that perform weapons firing events combined with other events (e.g., weapons firing with infiltration/exfiltration), complete a grade record for each set of events. Average the total scores achieved to arrive at the weapon system employment rating and percentage score.

**6.15. Instructions:**

6.15.1. Units fly low level navigation routes at altitudes specified in applicable AFSOC 55-series instructions, minimum published low level route altitudes, or altitudes commensurate with the scenario threat, whichever is higher.

**6.16. Mission Planning.** This encompasses the overall unit effort to successfully utilize the mission planning cycle to plan and execute the tasked mission. Evaluate the adequacy and scope of planning. Consider the following:

6.16.1. Use of all available planning resources.

6.16.2. Timely and thorough coordination with appropriate agencies.

6.16.3. Proper evaluation/application of capabilities, mission requirements, and threats.

NOTE: Do not plan excessive delays for timing purposes. Examples of excessive delays include unrealistic alternate timing legs, holding for time control purposes (unless approved by the team chief), and slower than normal airspeeds. Units should plan for realistic and appropriate route lengths, but in no case will the route be shorter than 5 minutes prior to the first inflight warning.

**6.17. Mission Reliability.** Evaluate the unit's ability to generate, load, and rig aircraft scheduled for employment missions. Mission reliability and success depend on whether an aircraft scheduled for an employment mission is loaded, rigged, and required aircraft systems are operational for the tasked mission prior to takeoff. Count the employment mission successful if the following criteria are met:

6.17.1. Infiltration and Exfiltration. The overall success of these events is whether the objective of the mission (insertion/removal of personnel and equipment, gun employment, air refueling, etc.,) is accomplished according to mission tasking. Aircrew will fly a preplanned low level profile IAW their associated 55-series regulations. Inflight, aircrews may modify preplanned flight path when required for time control, weather, Air Traffic Control, or simulated threats and associated threat maneuvers.

6.17.2. Time Over Target/Time Of Arrival (TOT/TOA). Score TOT/TOA as successful if within plus or minus 60 seconds; 61 seconds or more is considered an unsuccessful TOT/TOA.

6.17.3. Airdrop. Electronic (VMC/IMC) and visual airdrops will be evaluated. The majority of electronic drops will be to unmarked drop zones.

6.17.3.1. Drop Zone Size. IAW AFSOCR 55-60, minimum drop zone size will be mutually agreed upon by the Air Force and using unit commander having control of the operation/exercise. Drop zone size will vary and should be based on mission requirements, aircraft/aircrew capabilities, and items to be airdropped.

6.17.3.2. Scoring. For an airdrop event to be successful, the lead jumper of a stick or equipment must land within a 450 meter radius of the agreed upon point of impact or within the surveyed boundaries of the drop zone, whichever is less. All personnel and equipment must land on the surveyed drop zone in order to be counted as successful. IG personnel will attempt to determine the cause of each unsuccessful drop. If an unsuccessful drop is the result of an aircrew error (crew coordination, incorrect CARP or DZ coordinates, etc.,) or caused by other functions of the evaluated unit (i.e., JAI, command and control), the sortie will be scored as unreliable. If an unsuccessful drop is caused by equipment/load malfunction, or for a reason that can not be determined, the sortie will be dropped from the scoring database.

6.17.3.3. Record TOT based on the “green light” call from the navigator.

6.17.4. Airland Events (Fixed Wing). Runway criteria is IAW AFSOCR 55-130. Consider an event successful if:

6.17.4.1. For AF-marked landing zones, touchdown is in the first 500 feet of the runway and the aircraft slows to taxi speed within the available runway.

6.17.4.2. For RCL-marked landing zones, touchdown is in the RCL touchdown zone and the aircraft slows to taxi speed within the available runway.

6.17.4.3. For NVG landings to either marked or unmarked runways, the aircraft is able to safely turn off at the appropriate taxiway, or stop abeam the planned onload/offload point.

6.17.4.4. Record TOA based on the time during the initial approach that the aircraft passes abeam/over the touchdown zone or touches down.

**NOTE:** Crews may initiate go-arounds prior to or after touchdown. Score any touchdown prior to the touchdown zone as unreliable. Do not evaluate go-arounds due to factors beyond the control of the aircrew (personnel or equipment on the landing zone, etc.).

6.17.6. Inflight Refueling (Fixed Wing Receiver). Task appropriate units to demonstrate inflight refueling capability. The primary inspection criteria is a safe and successful transfer of fuel. For a single aircraft, or the lead aircraft in a formation to be successful, that aircraft must:

6.17.6.1. Accomplish a successful rendezvous.

6.17.6.2. Transfer the preplanned fuel load, updated fuel requirement, or limit the transfer to not exceed maximum gross weight.

6.17.6.3. The prebriefed or required fuel load is transferred to all aircraft prior to the end point.

6.17.6.4. Score TOA at the RZCT or ARCT as appropriate for the rendezvous.

6.17.7. Air Refueling (Tanker/Receiver). Evaluate IAW AFSOCI 11-202 Volume 23 and AFSOCR 55-18 Volumes 1 & 2, T.O. 1-1C-1-20. Evaluate the aircrew’s air refueling capability as an employment event. The primary requirement is safe, successful fuel transfer to support helicopter requirements.

6.17.7.1. Score time of arrival (ARCT) at the air refueling control point (ARCP). Aircrews should maneuver between the ARIP and ARCP to expedite the rendezvous. Time of arrival at the ARCP will not be graded if the crew is maneuvering to affect a rendezvous. Air Refueling TOAs for tankers will be on-time to 2 minutes late and 2 minutes early to on-time for receivers. Evaluators should bear in mind that AR TOAs often change in flight. In this case, use the TOA agreed to by all aircraft plus or minus 2 minutes, as appropriate.

6.17.8. Weapons Employment. Weapons employment should make sense within the framework of the exercise scenario. Each sortie evaluated must properly identify the target and select weapons and munitions appropriate for target destruction.

6.17.8.1. Record TOT based on the time the aircraft first enters the area, range, or other specified point approved by the IG.

6.17.8.2. The primary consideration for weapons employment is target destruction and timely mission accomplishment. This is a subjective evaluation based on effective fire.

6.17.10. Electronic Warfare/Self-Defense Capability (EW/SDC). Use guidelines in AFSOCMAN 11-1.

6.17.10.1. Units equipped with electronic warfare systems identify mission essential (ME) systems and ensure they are installed and operational.

6.17.10.2. Use actual or simulated airborne or ground threats to evaluate self-defense capability. Ensure simulated threats developed as part of the mission scenario are planned for and avoided or suppressed. The IG may observe crew response and planning against such scenario-driven threats or initiate threats to evaluate self-defense capability. The rating in the area is a function of observed tactical awareness and the employment of appropriate countermeasures.

6.17.11. STAR (MC-130E). Normally, one STAR event is tasked by the IG. Aircrews may make two attempts. Consider the recovery successful if the lift line is engaged on one or two attempts and the package is retrieved into the aircraft.

6.17.12. Leaflet Drops (Psychological Operations MC-130). Normally, one leaflet drop is tasked for units operating MC-130 aircraft. Evaluate either actual or simulated leaflet drops and specifically evaluate aircraft preparation and crew duties (at altitude) for leaflet dissemination. Consider the employment successful if aircrew performance results in a leaflet drop meeting mission requirements.

6.17.13. Hot Refueling:

6.17.13.1. General. Units qualified in hot refueling operations can expect to be tasked to demonstrate this capability to the IG. The IG will task a tanker for a minimum of two receivers using covert lighting and radio silence (comm out). The primary criteria when evaluating hot refueling operations is a safe and successful fuel transfer. Immediately discontinue fuel transfer for any leaks or other potentially dangerous situations. Procedures outlined in AFSOCRs 55-12 and 55-130, T.O. 00-25-172, AFI 23-201 and aircraft technical orders will be followed when conducting hot refueling operations. For grading, consider a hot refueling operation reliable if the tanker:

6.17.13.1.1. Briefs and displays an awareness of emergency procedures and escape routes.

6.17.13.1.2. Taxies to the proper location and follows marshaller's signals (if available) to properly position for the refueling operation.

6.17.13.1.3. Properly deploys the required equipment in the appropriate pattern for the number of receivers under NVG conditions within 20 minutes from setting the brakes until ready to accept a receiver.

6.17.13.1.4. Safely transfers the prebriefed/required fuel to the receivers using proper procedures.

6.17.13.1.5. Properly removes residual fuel from hoses and equipment and stows equipment aboard the tanker aircraft within 30 minutes from disconnect from the last receiver.

**NOTE:** A hot refueling operation (tanker) may be considered successful if no fuel transfer occurs due to reasons beyond the control of the tanker aircrew (e.g., receivers fail to show). In this case, the tanker aircrew must meet criteria listed above (except a fuel transfer is not required) to consider the event successful. If a leaking hose can be safely and efficiently removed/repaired/shut-off, refueling operations may continue. An additional 6 minutes is allowed to replace/repair a leaking hose or piece of equipment.

6.17.16. Psychological Operations (PSYOP) EC-130 Weapons Systems. This paragraph outlines specific ORI employment criteria for special operations EC-130 units. Rate subareas IAW basic regulation except where specified otherwise.

6.17.16.1. Mission Planning. Effective use of the mission planning cycle should ensure successful mission accomplishment IAW 6.16.

6.17.16.2. Mission Flight Profile. Aircrews must demonstrate adequate navigation to meet on-station requirements. Evaluate aircrew effectiveness against the assigned tactical electronic combat mission.

6.17.16.3. Psychological Operations Effectiveness. Evaluate on-station time based upon the time the aircrew actually supported the tasked mission versus the scheduled transmission time for tasked events. On-station time includes the period while crews may be characterizing and analyzing the signal environment or conducting ECM. Evaluate safe and effective transmitter and usage operation. Transmissions may be radiated on an approved or assigned frequency, or transmitted into “dummy load” if no frequency is available. If the aircraft is not in its assigned orbit, but is in a position from which the aircrew can effectively perform its electronic combat mission, count this time as effective on-station time. The flight profile may involve an orbit, track, or penetration route.

**6.18. Special Tactics Employment Inspection Criteria.** Assess Special Tactics units Mission Essential Task List (METL) proficiency through the performance of collective essential combat tasks IAW AFSOCR 52-1. Planners must develop the employment phase of the operation to mirror unit METL, Designed Operating Capability (DOC) statements and OPLANS force listings. A successful inspection requires completion of a cross section of collective essential combat tasks and should include the following:

6.18.1. Infiltration/Exfiltration. Normally a minimum of two tactical infiltrations and exfiltrations including one infiltration by parachute are tasked by the IG. Employ at least one Special Tactics Team on a field operation for a minimum of 72 hours remaining self sufficient. Airdrop or airland resupply is authorized if overall tactical scenarios permit. Given a mission scenario; essential elements of information; intelligence and logistics support; appropriate aircraft; perform duties in all environmental conditions. Consider the event successful if the applicable following standards are met:

6.18.1.1. Tactical (Land and Water) Static Line or Military Freefall Parachute Operations to Include Mission Equipment Airdrops. Plan, prepare and execute operation meeting all times specified in mission timetable. Ensure all safety standards are adhered to IAW applicable regulations. Team remains oriented and arrives at proper destination. TL conducts checks to ensure 100 percent accountability of personnel and equipment. Team performs duties as directed IAW OPOD and mission timetable. Drop site is sterilized and all unused items cached IAW

OPORD and mission timetable. Team is not compromised Mission, Enemy, Terrain, Troops and Time Available (METT-T) dependent.

6.18.1.4. Airland Operations Via Fixed or Rotary Wing Aircraft. Plan, prepare and execute airland operations meeting all times specified in mission time table. Ensure safety standards are adhered to when loading or unloading all personnel and equipment. Team remains oriented during flight and arrives at proper destination. Upon landing team exits aircraft IAW established SOPs and performs duties IAW OPORD. Landing site is sterilized IAW OPORD. Team is not compromised METT-T dependent.

6.18.2.4. Conduct Special Reconnaissance & Surveillance. Conduct required communications checks and situation reports with higher headquarter IAW time sequence established in mission execution checklist. Collect essential elements of information on objective area to support timely mission planning and meet identified mission time tables without alerting the enemy. Be prepared to receive additional friendly forces at times and location established in mission OPORD without alerting the enemy. Be prepared to establish and control assault zones or conduct turnover operations without interruption of terminal guidance services, at times and location established in the mission OPORD.

## Section F - Combat Support (Pg. 22)

**6.20. Home Station Mission Support.** Evaluate home station mission support procedures against the following criteria, as appropriate:

### 6.20.2. Aircraft Maintenance:

6.20.2.1. Departure Reliability. Evaluate the maintenance complex on its ability to prepare the aircraft for deployment or mission tasking to include required inspections, servicing, and the completion of necessary maintenance actions to allow the aircraft to complete the mission.

6.20.2.2. Maintenance Management. Evaluate all areas of maintenance on the positive control of maintenance efforts and the satisfactory accomplishment of management actions.

6.20.2.3. Aircraft Battle Damage Repair (ABDR). ORI tasked units are evaluated on the effectiveness of the ABDR program. As a minimum, the IG will review the following areas; readiness of ABDR kits to deploy and availability of the ABDR trained technicians and assessors.

6.20.2.4. Effective Use of Aircraft Battle Damage Repair (ABDR) on Damaged Aircraft. Evaluate serviceability of deployed ABDR kits, and effectiveness of personnel to properly assess and repair damaged aircraft using ABDR techniques. Assessment should include all facets which aid in determining aircraft status, estimated repair times, and mission degradation. ABDR repairs will only be accomplished on designated ABDR training aircraft or hulks.

**NOTE:** Ratings for management deficiencies will be determined by the mission impact of the specific deficiency in each category. For example, minor deviations in radio discipline may have little or no impact on the mission. However, poor radio discipline or OPSEC/COMSEC procedures that adversely impact the unit's ability to generate and launch aircraft may have a major effect on the mission.

### 6.20.3. Supply:

6.20.3.1. Mobility Readiness Spares Package (MRSP). Aircraft MRSPs for ORI-tasked units are evaluated for suitability for deployment. As a minimum, the IG will review the following areas: readiness to deploy, issue/accountability procedures, and general storage practices for MRSP assets. Supply inspectors who deploy to forward locations will also evaluate the ability of deployed supply personnel to efficiently operate from MRSP and the safeguarding of deployed assets. Grading will be IAW basic regulation.

**NOTE:** MRSP is evaluated only where AFSOC or AFSOC-gained supply personnel are accountable for the maintenance of MRSP. Discrepancies noted during the ORI involving MRSP management by non AFSOC personnel may be documented as an extract finding and forwarded to the appropriate MAJCOM. The discrepancies will not be scored on the inspection grade record.

6.20.3.2. Delivery Times. Evaluate base supply's ability to deliver off-the-shelf aircraft items to maintenance within 30 minutes. Do not rate supply functions when they are a non-AFSOC host responsibility. Delivery time is recorded for all delivery priority one and two issues only and will be based on the time from when the customer contacts supply to the time the customer signs for the item, if delivered by supply. For over-the-counter issues from decentralized warehouses, the time charged supply will stop once the part is available for customer pickup. Exclude requests which require referral back to the customer/maintenance supply liaison for additional information or verification (under circumstances equating to a kill action). The IG will determine if a mission impact occurred as a result of late deliveries; for example, mission cancellation or delays which caused a late takeoff.

6.20.3.3. Fuels. Evaluate fuels support in the following two areas:

6.20.3.3.1. Fuel Support of Aircraft. Observe aircraft refueling operations supporting the ORI for timeliness and fuel servicing safety observance. Refueling operation modes include both hydrant fuel system and mobile refueler services to aircraft. Locations with no active hydrant fuel system will be evaluated by observation of mobile refueler services to aircraft. Ratings will be based on timely dispatch of the fuel servicing operators and required equipment, observance of all fuel servicing safety procedures, and use of designated T.O. CL-1 mandatory checklists. The rating period will begin when the fuel servicing request is received at the Fuels Control Center (FCC) and will end upon the fuel personnel and equipment departing the aircraft. Equipment malfunctions and non-operator related discrepancies will be evaluated on a case-by-case basis. At locations having a Forward Area Refueling Point (FARP) commitment, evaluate fuel support to hot refueling operations using timelines listed in references under paragraph 6.17.13.

6.20.3.3.3. Timely fuel servicing response is defined as the time period specified in a Memorandum of Agreement/Understanding (MOA/MOU) between the fuels management officer and maintenance job control or specified in a fuels operating instruction (FOI).

6.20.3.3.6. Petroleum Damage and Deficiency Reporting (REPOL) (N/A to ANG). Evaluate knowledge of fuels operations damage reporting. Rate timely notification of disaster response agencies when applicable and submission of a complete and accurate REPOL within prescribed time frames. An inspection team member may present an ORI exercise fuel damage/deficiency scenario to fuels personnel and evaluate the following areas: expeditious notification of appropriate disaster response agencies; length of time to submit a REPOL to the inspector and accuracy response agencies.

6.20.5.4. Air Base Defense Forces. Consider the following subareas when evaluating ABD capability.

6.20.5.4.1. Predeployment Planning. Home station planning, preparation, and training to conduct operations. The unit must be able to form part of a perimeter defense to detect, engage, and defeat threats before they terminate aircraft operations or other mission essential operations. Consider unit training, equipment, mission documentation and planning, and intelligence efforts when evaluating pre-deployment planning.

6.20.5.4.2. Preparation for Defensive Operations. Evaluate unit mobility recall, processing plans/procedures, and flight command and control procedures. This includes coordinating and meeting response times. Consider the command element's planning for sector defense, enemy situation, and the area of operation.

6.20.5.4.3. Conduct of the Defense. Evaluate all tasks and functions accomplished to sustain an effective defense of the area of operations. This includes execution of the operation order, following principles of base defense, implementing troop leading procedures, effective use of the reserve force, and execution of combat and reconnaissance patrol tasking.

6.20.5.4.4. Redeployment. Evaluate the phase out of ABD operations, the repackaging of assets, and subsequent movement of mobility resources to home station or another employment location. This includes accounting for personnel and equipment, coordination of airlift requirements, and processing equipment, supplies, and personnel. Monitor equipment cleaning/turn in procedures and actions taken to accomplish necessary repairs.

6.20.9 Weapons. Unit's ability to provide proper protection procedures for classified information/material and verification of security clearance to perform tasked mission throughout the deployment process. The compromise of classified information which would jeopardize a mission or loss of life results in an unsatisfactory rating for this sub-area. Evaluate the ability

units to properly issue, secure, and transport weapons and munitions throughout the deployment process.

**6.21. Deployed Mission Support.** Score deployed mission support procedures as 40 percent of the unit combat support rating. Use a separate grade record for each deployed location. The overall grade for a deployed location where a chemical warfare exercise is conducted is limited to one grade higher than the grade received on the chemical/conventional warfare grade record. Grade deployed mission support procedures against the following criteria, as appropriate:

6.21.2. Aircraft Maintenance. Evaluate aircraft maintenance on its ability to rectify all mission essential and safety of flight discrepancies; meet aircraft servicing and configuration requirements; provide aircrews with mission-ready aircraft on schedule; and its ability to respond effectively to rapidly changing events in a dynamic environment.

6.21.2.1. Departure Reliability. Evaluate maintenance departure reliability. Evaluate helicopter build-up after closure.

6.21.2.2. Maintenance Management. Evaluate all levels of maintenance management on the overall management of maintenance resources, the ability to respond to rapidly changing events, and resourcefulness used to solve unique problems. Does the unit:

6.21.2.2.1. Use coordination and teamwork to accomplish mission tasking, identify potential problems, forward them for resolution, and participate in both resolution and execution of corrective actions? Disseminate information to all applicable agencies to aid decision-making?

6.21.2.2.2. Control communications by passing accurate, appropriate, and timely information concerning aircraft status, job progress, personnel availability, and work requirements to command and control agencies and functional areas? Maintain effective OPSEC/COMSEC/COMPUSEC?

6.21.2.2.3. Identify local limiting factors and properly elevate information for permanent resolution of problems? Exhaust all possible LIMFAC work-around?

6.21.2.2.4. Accurately identify and properly process supply requests?

6.21.2.2.5. Establish effective work schedules to achieve maximum capability with assigned personnel?

6.21.2.2.6. Effectively cross-utilize skills to handle surges and priority requirements?

6.21.2.2.7. Provide adequate supervision and assign personnel tasks commensurate with their skill level and training?

6.21.2.2.8. Ensure support equipment is serviceable, accounted for, available, and, in the case of precision measurement equipment (PME), properly calibrated? This includes deployed powered AGE, non-powered AGE, PME, tool kits, and special tools (e.g., engine change kits), as well as the support equipment furnished by the host at the deployed operating location.

6.21.2.2.9. Accurately control and document cannibalization actions?

6.21.6.3.4.1. Maintenance Control. The size of the deployment package, mission requirements, and number of maintenance personnel deployed will drive the level and amount of maintenance control performed at the deployed location. The following areas will be evaluated: control of resources, enforcement of safety directives, status reporting, and maintenance action tracking/scheduling (where applicable or practical).

6.21.6.3.4.2. Production Work Center Management. Evaluate production work centers in terms of:

6.21.6.3.4.2.1. Ability to provide the required serviceable equipment to accomplish the mission.

6.21.6.3.4.2.2. The performance of quality maintenance while complying with technical directives.

6.21.6.3.4.2.3. Compliance with safety directives.

6.21.6.3.4.2.4. Reporting on, responding to, and actions taken on equipment outages to ensure equipment serviceability.

6.21.6.3.4.2.5. Ability to perform damage repair as required to ensure equipment serviceability.

6.21.6.3.4.2.6. Overall equipment condition.

6.21.6.3.4.2.7. Availability, use, and control of technical data, tools, and test equipment.

6.21.6.3.4.3. Resources. The supply function is evaluated to determine the unit's capability to provide material to support unit tasking.

6.21.6.4. Survivability. This area evaluates the unit's ability to provide continuous communications support during simulated combat situations. Depending on the scenario and scope of the inspection, this area may be scored as the overall response of the parent wing/group as opposed to just the communications unit.

**6.22. Augmenting Mission Support.** Grade augmenting mission support against the following:

6.22.3.1. Deployment Planning. Evaluate the unit's ability to manage the recall and deployment of personnel and equipment in accordance with the Base Deployment Plan. Area includes alert recall procedures, unit assembly procedures, personnel and equipment processing.

6.22.3.2. Employment:

6.22.3.2.4. Evaluate proficiency of the control center, damage assessment teams, and recovery teams to accomplish war damage repair. Area includes pre-identified specialized repair teams, critical facility and utility priority repair lists, war damage repair status, personnel accountability and reporting, and communications and alert notification procedures.

Evaluate proficiency of the control center, damage assessment teams, and Rapid Runway Repair (RRR) teams to provide timely minimum operating strip (MOS) selection, explosive ordnance reconnaissance, and rapid, effective runway repairs. Area includes ability of unit to assess airfield condition, identify and mark unexploded ordnances (UXOs), accomplish MOS selection and demonstrate ability to assemble a Rapid Runway Repair (RRR) kit.